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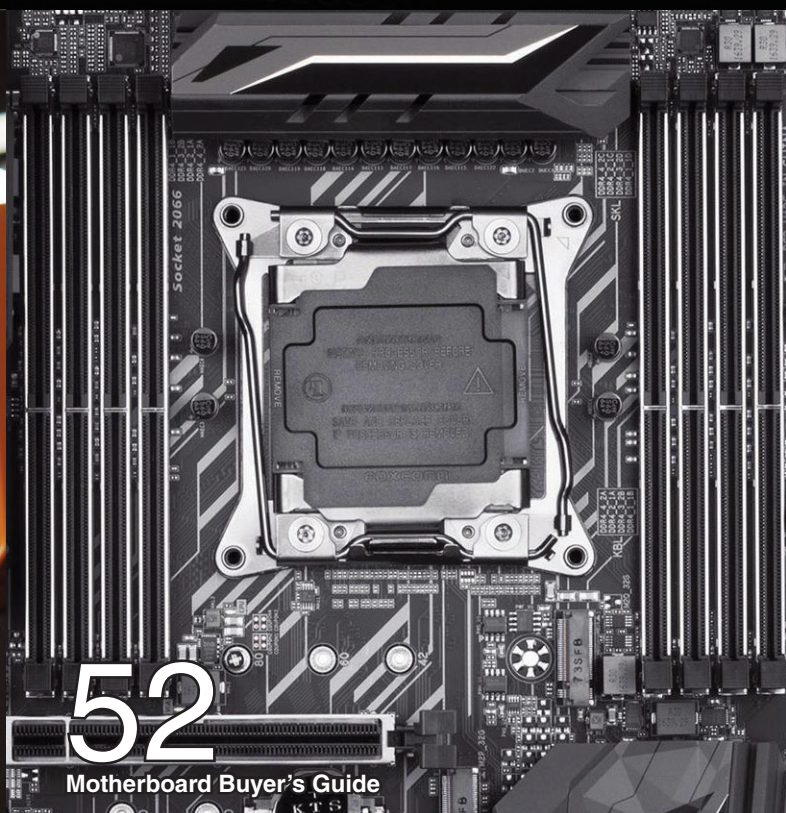
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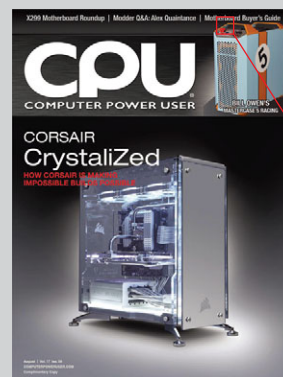
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Swiftech Has New, Limited-Edition Blocks

Swiftech has announced the Heirloom Series, a collection of cooling products that can be customized in a number of ways. The first product to be released in the new series is the Apogee SKF waterblock. At the heart of the Apogee SKF is new cooling engine technology. Swiftech says the block has fins that are only 125 microns thick (less than five-thousandths of an inch), and that this technology puts it a generation ahead of any competitors. The Apogee SKF is available in hundreds of color and finish combinations; there are five finishes for the top, six choices for the cover plates, eight colors for the logo, and two colors for the block's mounting brackets. The MSRP for the new Apogee SKF Heirloom Series is \$94.95. Swiftech says it has already begun producing customized orders for the new block, and that it will only be sold for four weeks or until the existing stock of cooling fins has run out, whichever comes first.

HyperX Announces New TKL Keyboard For Pro-Level Gamers

HyperX, the division of Kingston Technology that produces high-performance PC products, has announced a new addition to its Alloy keyboard line. The HyperX Alloy FPS Pro is a mechanical gaming keyboard that offers red LED backlighting and a choice of Cherry MX keyswitches (Red, Brown, or Blue). The Alloy FPS Pro is a tenkeyless model with a solid-steel frame and is designed for eSports professionals and pro-level players who like compact keyboards they can take on the road. There are presets for six lighting effects, as well as five brightness levels. The braided cable is 1.8 meters long and can be detached for travel. Other features of the Alloy FPS Pro include 100% anti-ghosting, N-key rollover, and a 1,000Hz polling rate. MSRP for the Alloy FPS Pro is \$79.99. HyperX says the keyboard will be available at retailers starting August 21.



WATCHING THE CHIPS FALL

Here is the pricing information for various AMD and Intel CPUs.

CPU	Released	Original Price	Last Month's Price	Online Retail Price*
AMD Ryzen 7 1800X (Zen)	3/2/2017	\$499	\$459.99	\$449.99
AMD Ryzen 7 1700X (Zen)	3/2/2017	\$399	\$349.99	\$389.99
AMD Ryzen 7 1700 (Zen)	3/2/2017	\$329	\$309.99	\$314.99
AMD Ryzen 5 1600X (Zen)	4/11/2017	\$249	\$239.99	\$239.99
AMD Ryzen 5 1600 (Zen)	4/11/2017	\$219.99	\$214.99	\$214.99
AMD Ryzen 5 1500X (Zen)	4/11/2017	\$189	\$189.99	\$189.99
AMD Ryzen 5 1400 (Zen)	4/11/2017	\$169	\$169.99	\$164.99
AMD A10-7890K (Godavari)	3/1/2016	\$164.99	\$149.99	\$134.99
AMD Athlon X4 880K (Godavari)	3/1/2016	\$94.99	\$91.85	\$79.90
AMD Athlon X4 845 (Carrizo)	2/2/2016	\$69.99	\$69.43	\$54.99
Intel Core i7-6950X (Broadwell-E)	5/31/2016	\$1,723**	\$1,449.99	\$1,695.00
Intel Core i7-5960X (Haswell)	8/29/2014	\$999**	\$1,009.95	\$1,073.52
Intel Core i7-6900K (Broadwell-E)	5/31/2016	\$1,089**	\$899.99	\$1,049.99
Intel Core i9-7900X (Skylake-X)	6/26/2017	\$999.99**	\$999.99	\$1,061.99
Intel Core i7-7820X (Skylake-X)	6/26/2017	\$599.99**	\$599.99	\$678.75
Intel Core i7-6850K (Broadwell-E)	5/31/2016	\$617**	\$479.99	\$459.99
Intel Core i7-7800X (Skylake-X)	6/26/2017	\$389.99**	\$389.99	\$415.99
Intel Core i7-7740X (Kaby Lake-X)	6/26/2017	\$349.99**	\$349.99	\$349.99
Intel Core i7-6700K (Skylake)	8/5/2015	\$359**	\$339.99	\$339.99
Intel Core i5-7640X (Kaby Lake-X)	6/26/2017	\$249.99**	\$249.99	\$249.99

* As of July 2017

** Manufacturer's estimated price per 1,000

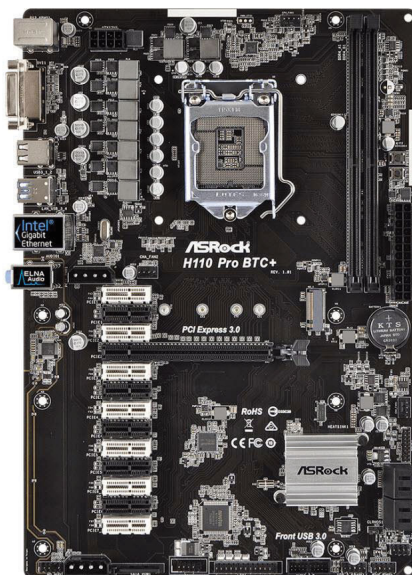


Team Group Announces Delta RGB

Memory maker Team Group has formally announced its newest line of DDR4 memory. The company gave previews of the new T-Force Delta RGB memory kits at Computex in June. The Delta RGB memory comes with an all-new heatsink that Team Group says is thinner and lighter than previous heatsinks because it is made with an “improved, high-quality metal.” The company says the new material helps dissipate heat faster. The heatsinks come in black or white. Team Group also is emphasizing the RGB capabilities of its new memory, and says it will be compatible with ASUS Aura Sync after a BIOS update from ASUS. The memory comes with a default LED mode the company calls “Force Flow,” but supports a total of nine lighting effects. The Delta RGB is available in kits of 8GB (4GB x 2) and 16GB (8GB x 2) at speeds of 2400Mtps, 2666Mtps, or 3000Mtps. Pricing for the new kits has not yet been released.

EKWB Creates M.2 NVMe Heatsink

EKWB specializes in liquid coolers and accessories, but the company occasionally branches out into other areas. Today the manufacturer released a new passive heatsink for NVMe SSDs that use the m.2 protocol. The EK-M.2 NVMe Heatsink is a compact heatsink that comes in black acetal or nickel. It's compatible with all m.2 devices that are single-sided and that use the 2280 format (22mm in width and 80mm in length). Those restrictions are important, as the heatsink has a front and a backplate that are held in place with small clips as they sandwich the SSD. The heatsink has raised ribs for radiating heat. EKWB says its NVMe heatsink can cut the SSD temps in your system by about 8 to 11 degrees by itself, and reduce them even more if you have a sufficient level of airflow. The EK-M.2 NVMe Heatsink is available for \$12.99 (black) or \$14.99 (Nickel) from EKWB's online store.



The ASRock H110BTC+ Supports A Baker's Dozen Of Graphics Cards

ASRock's H110 Pro BTC+ is a motherboard designed for mining digital currency. The board can run an incredible 13 AMD graphics cards at once, or a hybrid mix of AMD and NVIDIA graphics cards totaling up to 13 GPUs. To accommodate the power needs of all those cards, the motherboard has an 8-phase power design and three extra power connectors. (ASRock says users may need to add another PSU, as the company recommends at least 2400W of power if you are driving 13 GPUs. You'll need to buy a separate dual-power supply adaptor cable if you run a secondary PSU.) For miners wanting to run 13 AMD cards, ASRock recommends downloading the ethOS LINUX-based mining OS. The company recommends downloading GUIMiner for users who want to run a mix of AMD and NVIDIA cards. The ASRock H110 Pro BTC+ retails for around \$130.



Thermaltake Claims World First With Launch of iRGB PLUS PSU Line

Thermaltake first announced its iRGB Toughpower Premium Edition power supply at Computex in June. The company said the power supply was the “world’s first” to offer an RGB palette with 16.8 million colors. Now the PSU has been formally launched and is available at retailers. Enthusiasts who buy the new PSU will get a powerful, single-rail unit that is 80 PLUS Titanium certified for efficiency. The PSU has a Riing 14 RGB fan and a dozen LEDs that can be controlled individually. There are four lighting speed options (Slow, Normal, Fast, and So Fast), as well as seven lighting modes (Pulse, Wave, Ripple, Blink, RGB Spectrum, Flow, and Full Lighted). The unit is fully modular and supports Thermaltake Smart Power Management and other Thermaltake programs that help monitor and maintain power and also hold down system noise. The MSRP for the iRGB PLUS 1250W Titanium PSU is \$399.99.

HARDWARE MOLE



ADATA Announces XPG GAMMIX

ADATA has launched a new memory line called XPG GAMMIX D10. The DDR4 memory is available in factory speeds up to 3000MHz. The black PCBs on the modules have 10 layers to reduce signal interference, and there’s a heatshield (available in red or black) with the XPG logo and a serrated top that sandwiches the PCB. ADATA claims the heatshield gives the memory “considerable” headroom for overclocking. The XPG GAMMIX D10 modules are available in capacities ranging from a single 8GB module on up to 64GB (16GB x 4) and at 2400MHz, 2800MHz, and 3000MHz speeds. Kits at the first two speeds run at 1.2V, while the 3000MHz (PC-2400) kits run at 1.35V. ADATA says the memory modules offer great stability for overclockers. Pricing and availability dates for the new memory have not yet been announced.

Case Labs Unveils Bullet BH8 EATX

The compact Bullet chassis series from Case Labs is adding a big brother. The company has an EATX version coming that is roomy enough for custom liquid-cooling loops, but measures just 11.25 x 14.25 x 15 inches (HxWxD). The BH8 case has dual side windows plus a window on top for showing off components. Inside the 10-pound, all-aluminum chassis you’ll find a removable motherboard tray in the top compartment; the PSU goes in a lower compartment. There are up to a dozen mounting locations for SSDs, and the case comes with one HDD cage, but you can have as many as six with additional mounts). There are eight PCI slots. Fan mounts include two 120/140mm on top, two 120/140mm in front, and 2 x 80mm in the rear of the lower compartment. Case Labs says the MSRP for the Bullet BH8 is \$249.95; it will ship in early August.





Skrite Is A Social Networking App That Wants You To Watch The Sky

A new social networking app has launched that lets users communicate through a clever mix of augmented reality and geospatial messaging. Users download the app and then are able to virtually “skywrite” (hence the app’s name) messages that appear to float like contrails in the air at a particular location. You can only skrite a message at your current location, and once you skrite in a particular zone, you “own” the sky in that zone (a max of 25 Skrites can be written to a zone). Other users of Skrite can simply point their phones at the sky to see the messages people have left. You also can leave private Skrites; these messages can only be seen by people you designate. Another fun twist: you can connect with other Skrite users worldwide and “teleport” using AR to see Skrites written in the air around the globe. Visiting Paris? Leave a message there floating in the air for a loved one to find later. Skrite is available for free at the App Store.

The meeG App Lets You Turn Your Selfies Into Customized Emojis

Bad Apps, a company that doesn’t take itself too seriously, has created a new app for people who like to express themselves frequently on social media. The app, called meeG (and pronounced MEE-jee) makes it easy for users to turn their selfies into emojis that they can then send to friends in texts or chat sessions. Versions of meeG are available for both iOS (in the App Store) and Android (on Google Play). After you download the app for your smartphone, you go into your phone’s settings to add the meeG keyboard. Then you take a selfie, and the app walks you through the process of creating your personal emoji from the image. You can create dozens of meeg images and build your own emoji library. When you send a message to someone, you can attach your meeg (selecting the one you want from the meeG keyboard) just like you would with a regular emoji.



SOFTWARE SHORTS



Fedora Project Has A New Download

The Fedora Project has announced that Fedora version 26 is now available for download. There are three flavors of the Linux-based operating system: Fedora Workstation, for desktops and notebooks; Fedora Server, for servers in data center environments; and Fedora Atomic, a container platform for LDK (Linux/ Docker/Kubernetes) application stacks. The latest version of Fedora includes “thousands of improvements,” according to the release announcement in the community’s Fedora Magazine. The desktop software includes a new partitioning tool, and the desktop interface has been upgraded from GNOME 3 to GNOME 3.24. It includes new features such as an enhanced calendar, calculator, and a current weather update. A feature called “Night Light” automatically adjusts screen colors based on the time of day. You can see a full list of all the latest improvements in the Fedora Documentation Release Notes at getfedora.org.



Online Aftermarket For Car Parts Continues To Grow As Millennials Age

Millennials are very active online, and as they age and their purchasing power grows, they are creating seismic changes in different industries. Nearly 44% of millennials spend half or more of their overall purchasing dollars online, according to a report by research firm NPD Group, and now the car parts industry is feeling the effect. NPD says millennials are coming into their peak driving years, and they're now buying more aftermarket parts for their cars. They're also reading reviews online before making their purchases and watching videos about how to do car repairs. About 12% of all aftermarket car part purchases are now made online, and the percentage is growing. More than a quarter of aftermarket interior accessories, brake drums and rotors, and alternators are now bought online. The most popular online aftermarket segment is auto paint, where nearly a third (31%) of purchases are made online.

Most Broadband Households Watch Internet Video On The TV

Market research firm Parks Associates has been studying entertainment in the IoT era, and has found that just over 50% of U.S. households with broadband service are viewing Internet videos on their TVs. The firm says this marks a critical shift for the television industry, saying "the market has fundamentally changed." While broadcast and cable networks continue to see declines in viewership, the use of OTT (Over The Top) services is growing. More than 60% of U.S. households now subscribe to at least one OTT service, and Parks says one-third of households say they subscribe to multiple services. Other findings: 72% of non-pay-TV households subscribe to an OTT service, and 88% of video watching on computers is from non-linear sources. Nearly half (49%) of U.S. broadband households subscribe to Netflix, making it by far the most popular OTT service in the U.S.



SITE SEEING



Want The Real Scoop? Ask A Moo'er

LocalMoo is a new website that seeks to connect travelers around the world with local experts from their targeted travel destinations. These locals, which the site calls "Moo'ers," are able to earn income on LocalMoo by acting as an information resource or offering travel-related services to travelers headed their way. Travelers can make arrangements with Moo'ers to pick them up at the airport or to act as their travel guide to local points of interest. They can ask Moo'ers for their advice on the best places to stay or restaurants that serve authentic local cuisine. LocalMoo says people who live in a community and who share their knowledge about the local area are able to help tourists or business travelers get more out of their visits. The travel platform says it has already built a following and has local Moo'ers available from more than 50 countries. For more information on how the site works, visit localmoo.com.



Job Of The Month

The jury is still out on whether VR will become as prevalent in consumer households as TVs or gaming consoles, but a number of major companies continue to plow R&D dollars into the technology. Among the leaders in the consumer VR space is HTC with its well-regarded Vive headset. The company is currently looking for a Senior Software Developer in Virtual Reality for HTC Creative Labs in San Francisco. This person will create applications for the HTC Vive and new product prototypes and explore new user experiences made possible by VR technology. Ideal candidates will have serious technical chops and a designer's eye. You need five or more years of development experience in games or apps, plus you need to be a wiz with C# and the Unity game engine. You'll collaborate with teams and individuals in Taipei as well as San Francisco. VR experience is a big plus. If you want to be on the cutting edge of technology, VR is at the tippy tip. Plus you get to travel occasionally to Taiwan! See the website below for details.

Source: www.htc.com/us/working/careers

Goggles = Gaming

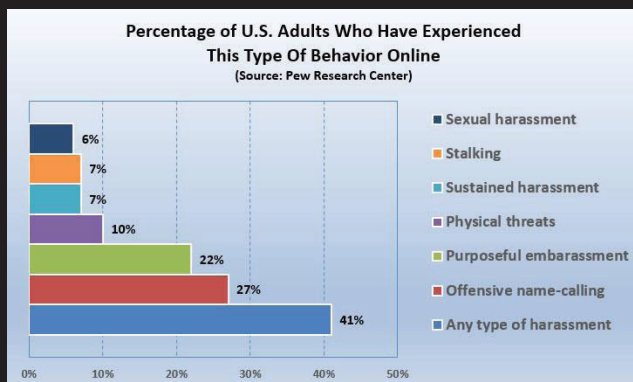
Virtual reality may help businesses train employees and help doctors with complex surgeries, but for most consumers, VR means a new way to game. Nearly 9% of U.S. broadband households will buy a VR headset in the next 12 months, according to a report by Parks Associates. About a quarter of households say they will use the devices for educational purposes and shopping. Around a third say they will use them to watch sports or other live events and for social interaction. Almost half intend to take virtual tours or watch entertainment videos. But two-thirds say they will use VR headsets to . . . yup . . . play games.

Source: Parks Associates



Civilized Behavior? That's So Passé, You Moron

It's a rough world out there. Tales of bad behavior are legion on the interwebs, but the problem goes far beyond ill-mannered retorts and childish name-calling. Pew Research Center surveyed more than 4,000 U.S. adults about their online experiences and found that 41% had been the victims of some form of abusive behavior. The online abuses ranged from name-calling to stalking and sexual harassment.



Ten percent of adults have received threats of physical violence over the internet. In all, Pew says about one in five Americans have been the victims of severe forms of harassment, including stalking or being harassed for extended time periods.

Source: Pew Research Center

RAW Numbers:

4.8%

The forecasted growth rate for tech spending by U.S. businesses and government in 2017 by Forrester. The market research company is forecasting a growth of 5.2% in tech spending for 2018.

Forrester

10%

The percentage of people who use smartphone apps or a personal assistant product (such as a smart speaker) and who use that product to manipulate and control another smart home device.

Parks Associates

1 million

The estimated number of businesses worldwide that will implement some form of artificial intelligence technology by 2022.

ABI Research

2 billion

The number of people worldwide who use the social media site Facebook each month. Facebook now has nearly 50% more users than there are people in China, the most populous country on Earth.

Facebook.com

\$6.1 trillion

The estimated value of the global "app economy" (includes spending across all mobile app stores, mobile commerce, and in-app advertising) by the year 2021, according to market research firm App Annie. The company estimated the value of the 2016 app economy at about \$1.3 trillion.

App Annie



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Daniel "Twister" Bolognesi's custom masterpiece, "Crystalized."

What makes a mod great?

If you think back to the most amazing PC projects you've ever seen, you'll very quickly come to the realization that the thing they have in common is that they don't look like anything else you've ever seen. Take, for example, Daniel Bolognesi's "Crystalized" mod, a featured build in Corsair's Builder Showcase (www.corsair.com/en-us/landing/builders-showcase). Odds are pretty good that you've never seen anything quite like it; it's a one-of-a-kind work of art, and it's the kind of mod that makes everyone who sees it wish they'd built it.

And to be sure, Bolognesi put work and imagination into this mod to make

it great. "He always looks at his builds from a perspective that's different from all the other builders I've ever worked with," Corsair's Blake Andes says. "He built it with a completely monochrome color scheme to give that opulent appeal, but then added in a splash of color with the purple coolant and purple LEDs."

Andes says Bolognesi used a CNC machine to mill out Crystalized's custom acrylic reservoir and water channels, and adds that he also has access to a laser cutter. "The nickel-plated tubing is his perfect finishing touch, and it totally adds the extra 'pop,' giving it that cherry-on-top appeal," he says.

But if you take a closer look at this breathtaking mod, you'll notice something

else: A lot of the components that help make this mod a custom showpiece are parts you can buy from your favorite retailer—parts that are made and sold by Corsair.

Crystal Series 570X RGB

Seasoned modders will tell you that choosing the right case can make or break any mod project, and for the see-through, chrome-and-glass look that Bolognesi was going for, the choice was clear: Corsair's Crystal Series 570X RGB.

This gorgeous ATX mid-tower case comes with tempered-glass panels on both sides, on the front, and on top, so it does an incredible job of showing off your components—and your hard work inside. It is also designed for

Advertisement

maximum airflow, to keep your components cool and help them perform better, longer.

HX Series HX1000

The power supply in “CrystaliZed” has a custom finish, but beneath the paint this unit is all Corsair. It provides kilowatt power, 80 Plus Platinum efficiency, and runs extremely quietly thanks to its 135mm fluid dynamic bearing fan, which uses Corsair’s ZeroRPM mode to shut down completely when it’s not needed. The HX1000 also comes with legendary Corsair reliability, thanks to 100% Japanese capacitors rated for 105-degree Celsius operation; the entire unit is engineered to provide maximum power output at 50 degrees Celsius, and comes with a 10-year warranty.

Best of all from an aesthetic standpoint, the HX1000 is a fully modular PSU, so you



will only ever have to work with the cables you need for the hardware in your build—and that makes it easier to keep your system looking clean and immaculate, even in a see-through case.

HD Series RGB Fans

Corsair fans have been keeping PCs cool for years, and the company provides a wide range of options, including both static pressure and high-airflow units to cover all the bases. HD Series RGB fans have 12 individually addressable RGB LEDs built into the frame and four built into the hub, giving you complete control over the color(s) displayed inside your case. These fans are at home showing off one color or several simultaneously, and they are built with nine ultra-thin fan blades to keep vibration—and, therefore, noise—to an absolute minimum.

Vengeance RGB DDR4

When you’re working to create a coherent color scheme inside your build, it’s important to avoid installing memory sticks that break it up rather than



contribute to that theme. CrystaliZed has Vengeance LED memory modules with a custom paint job, but the white glow of their LEDs does just as much to pull the look together as the paint.

Corsair’s Vengeance RGB DDR4 memory lets you add the specific colors and lighting

effects you need to complete your perfect look, especially when used in conjunction with Corsair LINK software. In addition, these gorgeous kits support XMP 2.0 overclocking profiles, are built on custom performance PCBs with tightly screened ICs, and have great-looking heat spreaders that also maintain optimal operating temps so that your memory is stable regardless of what you throw at it.

Premium Individually Sleeved PSU Cables

Bolognesi cut custom power supply cables to precise lengths and sleeved them himself for CrystaliZed, and they look great. If you’ve ever sleeved your own cables, though, you know that it is a pretty significant time commitment, and it requires a very particular set of skills.



If you lack either the time or the skills, Corsair has even more good news for you: the company’s Premium Individually Sleeved PSU cables are sleeved in paracord and come in multiple colors and color combinations so that you can get that custom look anyway.

Corsair cables also come in a variety of kits to help you get precisely the cable lineup you need, and they even come with cable combs so that everything stays right where it belongs at all times.

Get It Together

Creating your best mod yet still requires some work on your part, of course. There’s no substitute for attention to detail and a good eye, but thanks to a wide range of great-looking, high-performance parts from Corsair, making your next build look great just got a lot easier. ■

Find Your Core X Dance Partner

A Trio Of X299 Motherboards, Benchmarked & Compared

Intel's Core X-series processors are a dramatic shift for the HEDT (high-end desktop) platform. The biggest change is that there are two CPU lineups, Skylake-X and Kaby Lake-X, with vastly different architectures. By segmenting its Core X-series chips, Intel is able to expand power user choices, but there are some serious side effects. X299 motherboards support both processor lineups, yet available memory and GPU configurations will differ based on the CPU you choose.

Opting for a Kaby Lake-X CPU, for example, limits a system to dual-channel memory and the CPU only contributes 16 PCIe 3.0 lanes. Skylake-X, on the other hand, delivers what power users have come to expect from the HEDT platform, with support for quad-channel memory and up to 44 PCIe 3.0 lanes (with a minimum of 28 lanes). Both Skylake-X and Kaby Lake-X processors can support four PCIe 3.0 storage lanes from the processor, and the extra lanes on Skylake-X allow for a bit more flexibility for GPU and PCIe SSD configurations. For these reasons and a few others, we expect most enthusiasts to opt for a Skylake-X processor when building around X299.

The X299 chipset itself is another big HEDT transformation, and the changes on X299 are almost all for the better. Its predecessor, Intel's X99 chipset, was severely hampered for use with PCIe SSDs, because the chipset only had eight PCIe 2.0 lanes. As such, most X99 motherboards steal PCIe 3.0 lanes from the CPU to feed PCIe SSD bandwidth.

On X299, Intel provides the chipset with up to 24 PCIe 3.0 lanes to power multiple 32Gbps M.2 slots, PCIe 3.0 expansion slots, USB 3.1 ports, and other high-speed connectivity. X299 also natively supports up to 10 USB 3.0 ports and eight SATA ports.

As is typical with a processor architecture change, X299 brings along a new socket called LGA 2066, so you won't be able to use a Broadwell-E or Haswell-E processor. The LGA 2066 socket will support upcoming Core X-series chips, including the 18-core, 36-thread Core i9-7980XE. Intel Core X-series processors connect to the X299 chipset via a DMI 3.0 link, just like Intel uses on the mainstream Z170 and Z270 chipsets. The high-speed link offers up to 8GTps per lane and helps to support the additional flexibility of the X299 chipset.

Besides a common chipset, an attribute you can expect all X299-based motherboards to share is a comparatively costly price tag, with base models starting around \$250. Most X299 boards retail for more than \$300. If you pair X299 with a Skylake-X CPU, you'll understandably want to surround the processor with other premium parts. Our X299 roundup takes a look at three motherboards with plenty of enthusiast-oriented additions.

To get the most out of the motherboards in this roundup, we installed Intel's Core i9-7900X, an EVGA GeForce GTX 1080 Ti FTW3 GAMING, and 32GB of Corsair Vengeance LED DDR4-3200MHz memory. Optimal storage speed was provided by a 480GB

Patriot Hellfire SSD, and GIGABYTE's XP1200M provided system power. None of the boards we tested had any conflicts with this hardware setup.

MSI X299 GAMING M7 ACK

MSI typically releases a GAMING M7 variant for each new chipset, and the board often comes packed with amenities for performance enthusiasts. The X299 GAMING M7 ACK stays true to our expectations with support for high-speed memory, RAID configurations for PCIe SSD sans Intel VROC (Virtual RAID On CPU), Mystic Light RGB sync, built-in Killer wired and wireless connectivity, and voltage check points.

The X299 GAMING M7 ACK is built to handle the power and heat of Intel's Core X-series processors. To optimize power delivery, for instance, there are 12 power phases with load-line calibration and digital power control. The mainboard boasts an 8-pin EPS and a 4-pin ATX CPU power inputs, ideal for power-hungry Skylake-X processors. Similar to the other boards in this roundup, MSI installs an external clock generator that allows for a greater range of BCLK adjustments. The rear panel boasts a Clear CMOS button, as well as a BIOS FLASHBACK+ button to conveniently recover from any OC missteps.

MSI equips the motherboard with eight DIMM slots and includes a full-page handout that illustrates which slots you should use when installing system memory, depending on your processor. It's a small enough thing,

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

X299 GAMING M7 ACK\$399.99 | MSI | us.msi.com

Specs: Max memory: 128GB (DDR4-2667; Max OC: DDR4-4500); Slots: 4 PCIe 3.0 x16 (2 at x16, 1 at x8, 1 at x4), 2 PCIe 3.0 x1; Storage: 2 M.2 (1 type 2242/2260/2280, 1 type 2242/2260/2280/22110), 1 U.2, 8 6Gbps SATA; Rear I/O: 2 USB 3.1 (1 Type-A, 1 Type-C), 4 USB 3.0, 2 USB 2.0, 1 PS/2, 1 Ethernet, audio I/O, 1 S/PDIF, 2 Wi-Fi antenna ports, 1 BIOS FLASHBACK button, 1 Clear CMOS button; Form factor: ATX; Warranty: 3 years

but we appreciated the simplified installation. Optimized trace layouts allow the X299 GAMING M7 ACK to support high-speed modules. MSI qualifies the quad-channel memory support at up to DDR4-4133, while dual-channel memory support goes up to DDR4-4500MHz.

For expansion slots, there are four PCIe 3.0 x16 slots wired to operate at x16/x4/x16/x8 speed when paired with a 44-lane CPU. Up to 3-way SLI and CrossFire is supported on both 44-lane (x16/x16/x8) and 28-lane (x8/x8/x8) processors. With a 16-lane CPU, MSI allows for SLI and CrossFire (at x8/x8), but interestingly, a single GPU is only given x8 bandwidth.

There are also two PCIe 3.0 x1 slots, powered by the X299 chipset, for other add-on cards.

The two PCIe x1 slots reside next to the two M.2 slots. MSI installs its M.2 Shield FROZR over the M.2 slots to provide built-in thermal protection. Unlike the small metal M.2 Shield on MSI's Z270 motherboards, the Shield FROZR on the X299 GAMING M7 ACK is a large, thick metal block. MSI still preinstalls a thick thermal pad to help draw heat away from your M.2 SSD. The two M.2 slots utilize lanes from chipset, and you can use MSI's M.2 Genie to set up a high-speed RAID. MSI also includes a U.2 port, and this 32Gbps port will remain

active, even if you install PCIe SSDs into both M.2 slots.

The X299 GAMING M7 ACK's onboard wireless is provided by Killer's Wireless-AC1535 module that fits into the Key E M.2 slot near the rear I/O panel. The preinstalled module supports 802.11ac at up to 867Mbps and Bluetooth 4.1. The rear panel's wired connection is Killer's E2500 NIC, and the Killer Network Manager can utilize the wired and wireless connections to optimize network traffic for gaming duties.

MSI installs RGB LEDs in the heat-sinks and the rear I/O cover, and we particularly like the set of LEDs in the VRM heatsink that loom like a pair of eyes over the CPU socket. The board includes one RGB LED header to sync a 5050 LED strip with the LEDs on the motherboard (and other Mystic Light-compatible devices), and MSI includes a splitter to let you connect a second RGB LED strip.

The X299 GAMING M7 ACK delivered some of the best benchmark scores of the test group. In SiSoftware Sandra's Processor Multi-Media tests, for example, the mainboard was measurably faster than the other boards. SiSoftware Sandra's Memory Bandwidth Integer test (61.52GBps) and CrystalDiskMark's Sequential read/writes (2650MBps/984.3MBps) were two other benchmarks where the X299 GAMING M7 ACK flexed its compute muscles.

Based on features and peak performance, the X299 GAMING M7 ACK is our favorite model in this roundup. Of course, it's also the most expensive motherboard (with an MSRP of \$399.99), so it should probably perform the best. Even at \$100 more than the ASRock X299 Taichi, MSI deserves kudos.

ASRock X299 Taichi

The X299 version of ASRock's Taichi features a clockwork theme, just like previous Taichi models, with a few more intricate details that enhance

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the look. For example, ASRock adds a thick, metal gear-shaped PCH heatsink, and there are RGB LEDs under the gear that provide a cool backlight. ASRock also drops the white elements in favor of a grey, silver, and black color theme that feels more industrial. To drive performance, the X299 Taichi boasts a 13-phase power design, three 32Gbps M.2 slots, and four PCIe 3.0 x16 slots wired at x16/x8/x16/x8 speed.

ASRock lays out the X299 Taichi's expansion slots a bit differently than the other models in this roundup. MSI and GIGABYTE electrically wire the second PCIe x16 slot for x4, while the X299 Taichi allows for up to x8 speed. Despite not being listed as such in the manual, ASRock tells us that the second PCIe x16 slot can be used for a 4-way SLI or CrossFire configuration. We also like that the board allows for 3-way SLI and CrossFire (x8/NA/x16/x8) when used with a 44-lane or 28-lane CPU.

When using a Kaby Lake-X CPU that's limited to 16-lanes, the X299 Taichi only supports a CrossFire configuration—no SLI—at x8/x4 speeds. The four missing PCIe lanes are reserved for one of the three M.2 slots on the motherboard. Lack of support for SLI is something we rarely see even on relatively affordable boards with mainstream chipsets like Z270; this is just another reason we'd strongly recommend a Skylake-X processor for people investing in X299.

For system storage, ASRock provides three Key M, M.2 slots. There are two slots (M2_1 and M2_3) fed by the chipset and the one powered by your Core X-series CPU. On the other boards in the roundup, MSI and GIGABYTE provide tools to create a RAID with the chipset M.2 drives. On the X299 Taichi, you'll need to go through the process of remapping the drives via Intel Rapid Technology, which is a lot more time-consuming than using a custom-made utility. A 3-way RAID with PCIe SSDs with M.2 drives requires Intel VROC.

ASRock adds wireless communication by preinstalling an Intel 802.11ac/Bluetooth 4.2 combo module on the rear panel. For a truly speedy wired connection, the X299 Taichi features two Intel LAN ports (one i219V and one i211AT) that support teaming. One important caveat is that teaming isn't supported on Windows 10, which could prove problematic for power users. The rear panel also features two USB 3.1 ports (one Type-A and one Type-C), four USB 3.0 ports, and two USB 2.0 ports. ASRock includes support for front-panel USB 3.1 connectivity via an ASMedia ASM3142 chip.

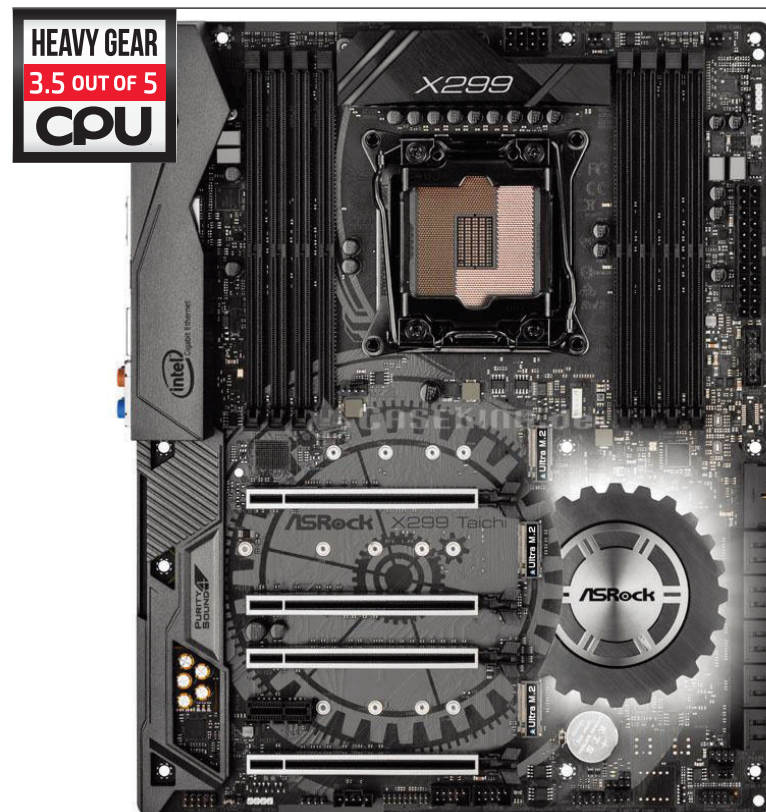
To control and sync RGB LED lighting, ASRock offers two RGB LED

headers that support 5050 RGB strips with a maximum power rating of 3A and a length of two meters or less. Interestingly, the RGB LED behind the PCH heatsink is the only onboard LED. The visual aesthetic of the board might be a bit more intriguing for modders and enthusiasts with a few more RGB LEDs, especially if the LEDs further accented the gear theme.

The ASRock X299 Taichi benchmark numbers lagged ever so slightly behind the competition in most cases, but none of the results were particularly alarming. For example, the POV-Ray 3.7 score of 4549 is only 29 points behind the top mark. The X299 Taichi did produce the best score in SiSoftware Sandra's

X299 Taichi

\$299.99 | ASRock | www.asrock.com



Specs: Max memory: 128GB (DDR4-2667; Max OC: DDR4-4400); Slots: 4 PCIe 3.0 x16 (2 at x16, 2 at x8), 1 PCIe 2.0 x1; Storage: 3 M.2 (2 type 2230/2242/2260/2280/22110, 1 type 2230/2242/2260/2280), 10 6Gbps SATA; Rear I/O: 2 USB 3.1 (1 Type-A, 1 Type-C), 4 USB 3.0, 2 USB 2.0, 1 PS/2, 2 Ethernet, audio I/O, 1 S/PDIF, 2 Wi-Fi antenna ports, 1 BIOS FLASHBACK button, 1 Clear CMOS button; Form factor: ATX; Warranty: 3 years

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

Processor Arithmetic tests, but as with POV-Ray 3.7, numbers were quite similar between all three motherboards.

ASRock makes some nice additions to the X299 chipset, such as the onboard Wi-Fi, USB 3.1 front-panel header, and dual Intel NICs. We'd have liked to see an easier way create a RAID 0 or 1 configuration with PCIe SSDs, but it's not a deal-breaker. Overall, the X299 Taichi's sharp looks, overclocking options, and power user enhancements make it worthy of a Skylake-X CPU.

GIGABYTE X299 AORUS Gaming 3

The X299 AORUS Gaming 3 isn't GIGABYTE's top-of-line AORUS board, yet it still includes several of the amenities found on the higher-end AORUS X299 mainboards. It's also a good example of the base features you're likely to see with X299 motherboards, such as dual M.2 ports.

The two M.2 ports on the X299 AORUS Gaming 3 are hosted by the chipset, rather than the CPU, and GIGABYTE easily supports RAID 0 and 1 configurations without the need for an Intel VROC upgrade key. (On the X299 AORUS Gaming 9 and 7, a third M.2 slot is hosted by the CPU and can only RAID with other PCIe SSDs using Intel VROC.) If you're planning a RAID with SATA SSDs, this board supports RAID 0, 1, 5, and 10 configurations—even if they are M.2 SATA SSDs.

All of the expansion slots on the X299 AORUS Gaming 3 are PCIe x16 slots, though only two (the top and third slot) are wired for the full x16 speed. The bottom PCIe x16 slot is wired for x8 speed, while the second and fourth slots are wired for x4 speed. This layout allows for plenty of space between the true x16 slots and maximizes airflow for SLI or CrossFire configurations; 3-way CrossFire and SLI are also supported if you use a 44-lane CPU, though the slot wired for x8 speed is next to the bottom of the PCB. Depending on your case, adding a third GPU might require the use of a single-slot card.

X299 AORUS Gaming 3

\$279.99 | GIGABYTE | www.aorus.com



Specs: Max memory: 128GB (DDR4-2666; Max OC: DDR4-4400); Slots: 5 PCIe 3.0 x16 (2 at x16, 1 at x8, 2 at x4); Storage: 2 M.2 (1 type 2242/2260/2280, 1 type 2260/2280/22110), 8 6Gbps SATA; Rear I/O: 2 USB 3.1 (1 Type-A, 1 Type-C), 6 USB 3.0, 1 PS/2, 1 Ethernet, audio I/O; Form factor: ATX; Warranty: 3 years

If you pair the X299 AORUS Gaming 3 with a Skylake-X processor, the motherboard supports up to 128GB of quad-channel DDR4 memory over eight DIMM slots. But similar to other X299 mainboards, the X299 AORUS Gaming 3 will disable half of the DIMM slots if you install a Kaby Lake-X CPU (due to its dual-channel architecture) and limit you to four DIMM slots and 64GB of system memory. GIGABYTE has qualified DDR4 modules as fast as 4200MHz for Skylake-X and up to 4400MHz for Kaby Lake-X CPUs.

GIGABYTE continues to evolve its support for RGB LEDs with its X299 AORUS lineup. The new boards

feature a WS2812 LED controller that supports digital LED strips, rings, or matrices where you can address the color and brightness of individual LEDs. As such, you can create color patterns and unique lighting effects. The X299 AORUS Gaming 3 includes one digital LED header (for 5050 digital LED strips) and two RGBW headers (for 5050 RGB or RGBW strips). You can control colors and effects for connected strips via the RGB FUSION utility and the BIOS.

The X299 AORUS Gaming 3 boasts a few onboard RGB LEDs, though not nearly as many as what you'll find on the Gaming 9 and Gaming 7. For example, this motherboard lacks

RGB LEDs in between the DIMM slots and the rear I/O cover, which leaves the upper portion of the board comparatively dark. The entire lineup lacks the LED strip along the right side of the board—a feature we liked on many AORUS Z270 motherboards.

In our benchmark results, the X299 AORUS Gaming 3 put the 10-core, 20-thread Core i9-7900X to good use in Cinebench 15 (2194 points) and POV-Ray 3.7 (4549.29 pixels per second). 3DMark's Fire Strike Extreme test displays the system's overall CPU and GPU capabilities with a Graphics Score of 14232 and a Physics Score of 24036. SiSoftware Sandra's Memory Bandwidth test (57.5GBps) demonstrates the power of X299's quad-channel support.

The X299 AORUS Gaming 3 manages to adequately support both the enthusiast class (Skylake-X) and mainstream (Kaby Lake-X) processors and other high-end hardware. The \$279.99 price tag makes it one of the most affordable X299 motherboards currently available—ideal if you're looking to make a little more room in the budget for a Skylake-X CPU.

Just The Start For X299

Compared to previous Intel chipset releases, it's safe to say that motherboard manufacturers didn't have as much time to develop complete lineups for X299. When Z270 was released, for instance, most board partners had several different series and options that covered most price points. X299 is coming along a bit more slowly—likely doubt due at least in part to the unprecedented breadth of CPUs they must support—and we've yet to see some of the flagship options with premium overclocking features. Of this group, performance enthusiasts will likely be drawn to the MSI X299 GAMING M7 ACK. That's not to say there aren't compelling reasons to go with the ASRock X299 Taichi or the X299 AORUS Gaming 3, as the mainboards are decent entry-level options for the X299 chipset. ■

BY NATHAN LAKE

Benchmark Results	MSI X299 GAMING M7 ACK	ASRock X299 Taichi	GIGABYTE X299 AORUS Gaming 3
MSRP	\$399.99	\$299.99	\$279.99
3DMark Fire Strike Extreme	13448	13409	13611
Graphics Score	14037	14033	14232
Physics Score	24066	23848	24036
Graphics Test 1	74.62	74.44	74.82
Graphics Test 2	51.63	51.69	52.76
PCMark 8			
Creative Score	5817	6082	6598
SiSoftware Sandra 2017			
Dhrystone AVX2 (GIPS)	456	461.7	459.7
Whetstone AVX (GFLOPS)	270.67	271	268.4
Multi-Media Integer AVX2 x32 (Mpixels/s)	1,630	1,450	1,430
Multi-Media Long-int AVX2 x16 (Mpixels/s)	580	516.65	513.5
Multi-Media Quad ALU x1 (Mpixels/s)	5.11	5.15	5.07
Integer B/F AVX/128 (GBps, memory bandwidth)	61.52	52.43	56.9
Floating B/F AVX/128 (GBps, memory bandwidth)	54	53.74	57.5
CrystalDiskMark 5.1.2 (MBps)			
Sequential Read (Q32T1)	2650	2552	2503
Sequential Write (Q32T1)	984.3	782.4	800.2
Random 4K Read (Q32T1)	679.3	623.3	675
Random 4K Write (Q32T1)	665.4	631.9	654.8
POV-Ray 3.7 (Pixels/s)	4578	4549	4549.29
Cinebench 15 (Points)	2186	2178	2194
Games (2,560 x 1,440)			
Metro: Last Light (Very High, 16xAF; SSAA off)	122fps	123fps	126fps
Dying Light (High, AO On, AA On, Vsync Off)	163fps	160fps	162fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	110fps	112fps	117fps

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



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REALFORCE RGB

Topre's Latest Gets A Nice Price For August, September



Late last year, Topre launched an RGB-backlit version of its highly-praised REALFORCE keyboard, and since then, the response from Topre's customers has been ecstatic. We're not at all surprised, either. In our positively ancient review of the Topre Type Heaven, we called it one of the most comfortable keyboards we've ever used, saying "The Type Heaven is like a behavioral psychology experiment where pressing a key yields a treat, only pressing each key on the Type Heaven *is* the treat."

With the REALFORCE RGB, that lovely satisfying typing experience is back, but now it's sporting a more gamer-friendly fully-customizable per-key RGB backlight. In an effort to spread the word about the joy of typing on the REALFORCE RGB to gamers, the Japanese company is dropping the price to \$199.99, though only temporarily. After September, the REALFORCE RGB will be back at its \$232 MSRP.

A Legacy Of Innovation

When you think about quality keyboard switches, the first manufacturer that pops into your head is probably the German-based Cherry, but Topre first started making

keyboards in 1983, right around the same time that Cherry started. The goal for Topre was to take the no-contact chatter-free feel of rubber dome-style switches and engineer them to be better in every imaginable way. The result of their labors is a keyswitch that's a bit of a hybrid between membrane and mechanical, but it's unlike any other hybrid switch we've used.

A Different Kind Of Dome

The electrostatic capacitive (or "electro-capacitive," as Topre refers to it) keyswitch starts with the same PCB as any other keyboard, but when you press a key to register an input with the REALFORCE RGB, the rubber cone collapses, allowing the inner peak of the dome to come into contact with the capacitive sensing circuit on the PCB.

The sheet of rubber domes looks a lot like the rubber dome sheets that you'll find inside just about every inexpensive keyboard you'll come across, but any similarity between Topre's switches and the cheap alternatives ends there. Installed atop each dome on the Topre switch is a conical spring, which not only adds a subtle amount of resistance, but

also pushes the keycap back up as your finger lifts off. This sensation, added to the rubber dome's popping action, results in a snappy response that's truly unlike anything we've experienced with most common mechanical switches.

Above the dome and spring is a plastic cylinder with a flat base that keeps the keycap straight and firm as it drops and rises. The impact of the cone base against the keyswitch's housing results in an audible clack. Because this feedback occurs later than the feedback we're used to on MX Blue and equivalent switches, the REALFORCE RGB initially sounded like each keystroke was followed by a rapid echo. This is another thing that distinguishes Topre's switches from those on most mechanical keyboards. There are Topre keyboards that install a rubber O-ring between the base of the plastic cylinder and the switch's housing to eliminate or dramatically reduce the sound of the key snapping back home, but frankly, we've grown to love the noise. By comparison, this Topre keyboard is generally quieter than most of the clicky keyboards we've tested. Light typers who tend to barely lift their fingers



off the switches will also experience a less pronounced feedback.

Although these switches have a remarkably different feel from standard mechanical switches, their 45cn actuation force makes them most similar to Cherry MX Reds.

Mix & Match Your Keycaps

The REALFORCE RGB's appeal for gamers and keyboard enthusiasts at large isn't limited to merely the backlighting. The traditional Topre switches tend to only support Topre-compatible keycaps, which is fine as long as you love the keycaps that your keyboard ships with. However, the cylindrical plunger of this keyboard's switches have been modified to feature the MX-compatible cross-shaped stem. This means that any keycaps you own or buy that are built to

work with Cherry MX keyboards will also work on the REALFORCE RGB.

That being said, the keycaps on this unit are of very high quality. They're made of ABS plastic, and have a slight matte finish to them. They're double-shot with an inner translucent plastic, and the surface of the keys feels perfectly flush. This means that the legends won't ever rub off, the keys are easy to clean, and they'll look good for as long as you own the keyboard (assuming you occasionally clean them).

16.8 Million Reasons We Love The Backlight

The RGB LEDs on this keyboard are actually built into each switch, but the clear acrylic housing on the top half of the switch lets just the right amount of light bleed through. To help reflect that light between the keys is a white backplate that surrounds the switches.

There are two ways to adjust the lighting on the REALFORCE RGB: via the software application, or using the onboard RGB function keys. For instance, you can press the FUNCTION key and the INSERT or HOME keys to cycle through the lighting colors and effects. The FUNCTION key and PAGE UP key

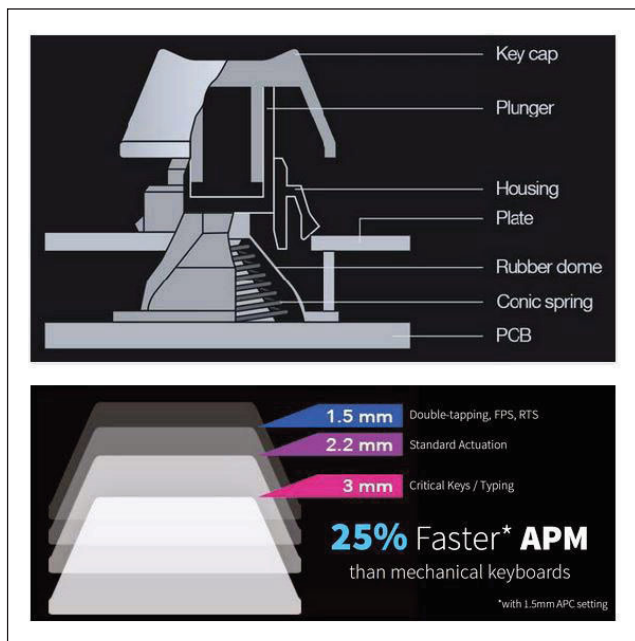
combo lets you cycle through your custom preset modes. The FUNCTION key plus the DELETE, END, and PAGE DOWN keys let you adjust backlight brightness, turn off the backlighting, and enable demo mode, respectively.

APC FTW

We saved the Actuation Point Changer feature of the REALFORCE RGB for last because it's such a game changer. Topre's unique switch and key-position-sensing design enables the keyboard to sense 256 distinct points of actuation along the 4mm of travel for each key. The firmware for this keyboard is programmed so that the user can choose between three of these actuation points, at 1.5mm, 2.2mm, and 3mm. With its lightest setting, the REALFORCE RGB becomes one of the fastest keyswitches you can buy, making it ideal for fast double-tapping or lightning-fast response in first-person shooters or real-time strategy games. The 2.2mm setting is fairly standard, and this keyboard's default setting. For those who prefer to fully bottom out the keys, there's the 3mm setting that effectively eliminates accidental keystrokes and requires a heavy hand (fingers). There's even an APC key in the upper-right corner that lets you swap between the all-key APC settings on the fly. If you want to adjust the APC on a per-key basis, the intuitive software lets you do that.

Bold, Beautiful & Unique

If you've read this far, it's safe to assume you care about the feel, look, and performance of your keyboard. The Topre REALFORCE RGB excels in all of those categories, and it has the unique APC function that you simply won't find on a Cherry MX board anywhere. If nothing else, keyboard lovers owe it to themselves to get their hands on a Topre to feel the difference. For more information, check out www.facebook.com/topre.realforce, and remember, the special \$199.99 price is only available for a limited time. ■



**GA-AB350N-Gaming WIFI**

\$114.99

GIGABYTE

www.gigabyte.us

GIGABYTE GA-AB350N-Gaming WIFI

When the AM4 platform was first released, AMD announced two chipsets, X300 and A300, designed specifically for small form factors. SFF builders have to be a bit disappointed that months later there are still no X300 or A300 options available. Fortunately, a few enterprising motherboard makers have managed to fit the X370 and B350 chipsets onto microATX and Mini-ITX form factors. GIGABYTE shrinks the B350 chipset down to the Mini-ITX form factor with the GA-AB350N-Gaming WIFI and still found some room for power user improvements.

Despite not being designed for use on small form factor systems, the B350 is a fine choice for a Mini-ITX mainboard. One of the important caveats with B350, when compared to the X370 chipset, is that B350 doesn't support SLI and has limited capabilities for CrossFire. But that's not a problem on Mini-ITX because there's only room for one expansion slot. B350 also offers fewer general purpose lanes and less connectivity for SATA devices than X370. Again, Mini-ITX boards typically don't

have room for many extras that can't fit onto the rear I/O panel, so the B350 chipset is no real detraction.

One thing we really liked about the B350 chipset is that AMD still allows for overclocking, and GIGABYTE plays this up with server-level chokes and digital CPU power delivery. The latter is powered by International Rectifier controllers that use intelligent ICs to evenly distribute thermal load. As is common on Mini-ITX motherboards, the GA-AB350N-Gaming WIFI features only two DIMM slots. You can install up to 32GB of memory, and GIGABYTE has modules and kits operating as fast as 3,200MHz.

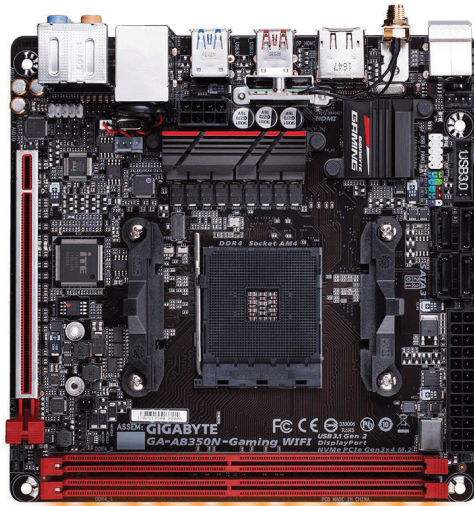
Next to the DIMM slots, along the side of the PCB, GIGABYTE installs a few RGB LEDs that create a backlight effect. If your small form factor build includes RGB LED light strips, you'll also like that the GA-AB350N-Gaming WIFI has two RGB pin headers to help you sync up system illumination. Speaking of headers, the two fan headers on the GA-AB350N-Gaming WIFI feature a hybrid design with support for either a PWM or Voltage mode. In the PWM mode, the

motherboard can base fan speed off one of the five onboard temperature sensors.

On the AM4 platform, AMD introduces built-in support for PCIe SSDs, as Ryzen processors can feed up to four PCIe 3.0 lanes to high-speed storage devices. The Mini-ITX form factor doesn't offer a lot of free space, at least on the top of the board, for an M.2 slot and the corresponding mounting holes. Breaking convention, GIGABYTE installs the M.2 slot on the backside of the PCB. The GA-AB350N-Gaming WIFI also offers four 6Gbps SATA ports, which support RAID 0, 1, and 10 configurations.

Speaking of layout, there's precious open space on this board. And while that speaks to GIGABYTE's engineering prowess, the cramped layout does lead to some odd header positions. For example, the 8-pin CPU power header is jammed between the VRM heatsink and the rear I/O panel—which makes for some ugly power cable routing. But with the SATA ports, front panel connectors, and 24-pin main power on the top of the board, there's just no space for it in the usual location. The layout does allow the board

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



to support AMD's Wraith Max CPU cooler with sufficient clearance for power connectors and memory.

To enhance sound quality, GIGABYTE installs Realtek's ALC1220 codec that supports up to 120dB SNR, multi-channel surround sound, and hardware decoding of DSD128. The motherboard also features a smart headphone amp that automatically detects the impedance of your headset or headphones to deliver a low, medium, or high impedance audio.

It should be no surprise that this motherboard comes with Wi-Fi (it's in the title, after all), and the built-in combo module that supports 802.11ac (at up to 433Mbps) and Bluetooth 4.2. The motherboard's wired NIC is made by Realtek. In GIGABYTE's full-size boards, we often see an Intel or Killer-branded NIC, but we didn't have any problems with the Realtek NIC during our testing. The Realtek NIC works with the cFos Speed utility to automatically prioritize network traffic.

The B350 chipset supports high-end Ryzen 7 processors, so we went ahead

and tested the motherboard with AMD's current flagship Ryzen 7 1800X, as well as the AORUS Radeon RX580 XTR 8G and 16GB of Corsair Vengeance DDR4-2933MHz. The GA-AB350N-Gaming WIFI, in turn, produced excellent results in our processor-intensive tests—highlighted by 1634 points in Cinebench 15 and 3386 Mpixels per second in POV-Ray 3.7. The AORUS 580 chipped in with games to deliver better than 60fps in Metro: Last Light (67fps) and Dying Light (70fps).

GIGABYTE infuses the GA-AB350N-Gaming WIFI with some fairly robust hardware support, considering the limited PCB space of the Mini-ITX form factor. The M.2 slot on the back of the board, in particular, is a noteworthy piece of engineering. SFF enthusiasts have few Mini-ITX options on the AM4 platform, and this GIGABYTE mainboard immediately vaults into the top option for power users. ■

BY NATHAN LAKE

Specs: Max memory: 32GB (DDR4-2667; Max OC: DDR4-3200; Slots: 1 PCIe 3.0 x16; Storage: 1 M.2 (type 2260/2280), 4 6Gbps SATA; Rear I/O: 2 USB 3.1 Type-A, 4 USB 3.0, 2 USB 2.0, 1 PS/2, 1 Ethernet, 2 Wi-Fi antenna connectors, audio I/O, 1 S/PDIF, 1 HDMI, 1 DisplayPort; Form factor: Mini-ITX; Warranty: 3 years

Test System Specs: Processor: AMD Ryzen 7 1800X; GPU: AORUS Radeon RX580 XTR 8G; Memory: 16GB Corsair Vengeance DDR4-2933MHz; Storage: Kingston 240GB HyperX SSD; OS: Windows 10 Enterprise

Benchmark Results	GIGABYTE GA-AB350N Gaming WIFI
3DMark Fire Strike Extreme	6083
Graphics Score	6331
Physics Score	19087
PCMark 8	
Creative Score	5408
SiSoftware Sandra 2017	
Dhrystone AVX2 (GIPS)	303.88
Whetstone AVX (GFLOPS)	195.28
Multi-Media Integer AVX2 x32 (Mpixels/s)	572.12
Multi-Media Long-int AVX2 x16 (Mpixels/s)	167.84
Multi-Media Quad ALU x1 (Mpixels/s)	3.83
Floating B/F AVX/128 (GBps, mem bandwidth)	34.26
CrystalDiskMark 5.1.2 (MBps)	
Sequential Read (Q32T1)	534.2
Sequential Write (Q32T1)	268
Random 4K Read (Q32T1)	194.4
Random 4K Write (Q32T1)	136.9
POV-Ray 3.7 (Pixels/s)	3386
Cinebench 15 (Points)	1634
Games	(2,560 x 1,440)
Metro: Last Light (Very High, 16xAF; SSAA off)	67fps
Dying Light (High, AO On, AA On, Vsync Off)	70fps
Witcher 3: Wild Hunt (Vsync Off, Unl. FPS, Ultra)	42fps

**Sound BlasterX AE-5**

\$149.99

Creative Labs

us.creative.com

Creative Labs Sound BlasterX AE-5

For years, sound card manufacturers have really only had to be concerned with one of the five senses. And for years, they've done a pretty good job, presenting richer, fuller sounds in our games, music, movies, and everything else that we need to hear. As crazy as it might seem, though, sound cards may need to appeal to more senses in order to stay relevant. Take a look at Creative Labs' Sound BlasterX AE-5 if you require proof.

No really, take a look. The AE-5's Aurora Reactive Lighting System brings LED lighting to the Sound Blaster family. Big picture, there's some strategic sense to the move. Obviously, LED-lit components have exploded in popularity to the point that not including them on hardware may be a deficiency for some enthusiasts. Top-shelf motherboards are already packed with them, and they also regularly feature high-end integrated sound chips. The Aurora system is one of Creative's attempts to woo power users into its camp.

The "System" in "Aurora Reactive Lighting System" is more than puffery, too.

In addition to some LED accents (including the logo on the AE-5's horizontal edge) on the card itself, Creative included an RGB controller and a 4-pin RGB header. To make certain that header has something to do, Creative gives you one 30cm LED strip (that's 10 LEDs, for anyone keeping score at home) with the AE-5; we appreciated the included extension cable, too, as it made wire management a little easier. Fire up Creative's Sound Blaster Connect software and punch in a custom color. One of those 16.8 million possible colors will satisfy you. The Sound Blaster Connect's LED controls are actually well executed; we expected bolted-on functionality, but it's clear to us after using the software controls that Creative took the AE-5's LED capabilities seriously. Additionally, if your motherboard doesn't belong to the LED Generation, the AE-5 is a handy way add such functionality.

Looks aside, the AE-5 happens to be a dynamite sound card. It's equipped with a 122dB 32-bit/384kHz ESS Sabre DAC, but you will need Windows 10 to take advantage

of the full fidelity. Knowing that the bulk of its customers will be gamers who regularly have a pair of cans strapped to their head, Creative deploys its Xamp. Rather than a single amplifier IC driving both left and right channels, Xamp uses two. Its 1Ω impedance is ideal for headphones up to 600Ω.

We installed the AE-5 and took it for a spin in *Left 4 Dead 2*. We were surprised to hear the range of sound it was able to coax out of a \$50 HyperX headset. Shotgun blasts resonated with deep bass, and pistol shots sounded crisp. When the action heated up, we thought the AE-5 distinguished itself by never letting the uproar become a muddled mess. Similarly, the sound card did a fine job presenting Metallica's "The Call of Ktulu" collaboration with the San Francisco Symphony.

Creative's Sound BlasterX AE-5 is sweet, and it's priced accordingly. However, if you're an audiophile also in search of an LED command center, this is the sound card you need. ■

BY VINCE COGLEY

Specs: Interface: PCIe; Dimensions: 0.79 x 5.71 x 5.04 inches (HxWxD); Dynamic range: 122dB; Audio connectivity: 1 x 1/8" (3.5mm) Mic In/Line In, 1 x TOSLINK optical out; 1 x 1/8" front out, 1 x 1/8" rear out, 1 x 1/8" center/sub out, 1 x 1/8" (3.5mm) headphone out; Additional connectivity: 1 x front panel header, 1 x RGB LED header; Audio technologies: BlasterX Acoustic Engine, CrystalVoice, Scout Mode

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

**Core i7-7740X**

\$339

Intel

www.intel.com

Intel Core i7-7740X

In last month's review of the Intel Core i9-7900X, there were two caveats keeping us from giving the platform an unmitigated recommendation. The first is the fact that the platform's most powerful processors won't launch until October. The second is that Intel decided to open the HEDT platform to a subset of aspiring enthusiasts who might buy this processor and an X299 motherboard in the hopes that they'll be able to upgrade to a Skylake-X processor and quad-channel memory at some point in the future. It's a nice idea, but realistically the number of builders for whom this scenario will be feasible is pretty small. Some people might even say they don't exist.

But before we start into the leprechauns and unicorns portion of this review let's take a closer look at the Intel Core i7-7740X and what it brings to the table. This is just a Kaby Lake Intel Core i7-7700K with the graphics engine disabled and the core clocked up 100MHz. It's a quad-core processor with Hyper-Threading enabled for managing up to eight concurrent threads at a time. It has a 4.3GHz core clock, and a Turbo Boost 2.0 frequency of up to 4.5GHz, which is the same TB2 frequency as on the 7700K. There's 8MB of Intel Smart Cache, an 8GTps DMI 3.0 bus, a dual-channel memory controller with a slight bump to support up to DDR4-2666, and 16 PCIe 3.0 lanes. It has a 14nm process-based die, it supports everything Kaby Lake supported last year (unless said feature depended on the Intel

HD Graphics 630), but it runs at a 112-watt TDP instead of the 91-watts of the 7700K.

The major thing that differentiates this processor from the 7700K is that it requires an X299 motherboard, any of which will cost a fair amount more than comparable Z270 motherboards due to the required support for quad-channel memory and up to 44 PCIe lanes that this processor can't tap into. The big takeaway is this; the Intel Core i7-7700K is the star of the show on the Z270 platform, but on the X299 platform, the Intel Core i7-7740X comes off looking like a dud.

When it comes to overclocking, this processor again failed to impress. No matter how much we tweaked the voltage, and tried to keep temps in check with a 240mm closed-loop liquid cooler, this processor hit a hard ceiling at 5GHz, which is the same overclock we managed with the 7700K.

Kaby Lake-X processors are strange products created to appeal to a rare (or nonexistent) user type. Our advice; stick a Skylake-X in your X299 motherboard, go with Z270 and a vanilla Kaby Lake, or buy AMD. ■

BY ANDREW LEIBMAN

	Intel Core i7-7740X	Intel Core i7-7740X OC
3DMark Fire Strike Ext.	12,969	13,137
Graphics Score	14,265	14,268
Physics Score	14,551	16,034
Graphics Test 1	76.22fps	75.77fps
Graphics Test 2	52.29fps	52.52fps
Physics Test	46.19fps	50.9fps
Combined Test	32.71fps	32.77fps
PCMark 8 Creative Score	5,891	6,217
Sandra 2017 Platinum		
Dhrystone Integer Native AVX2 (GIPS)	205.31	226.39
Whetstone Single-float Native AVX (GFLOPS)	120.69	136.12
x32 Multi-Media Integer AVX2 (Mpixels per second)	592.9	662.81
x16 Multi-Media Long-int AVX2 (Mpixels per second)	215.29	239
x1 Multi-Media Quad ALU (Mpixels per second)	2.42	2.62
x16 Multi-Media Single-float FMA (Mpixels per second)	524.66	584.4
Integer Memory Bandwidth B/F AVX/128 (GBps)	36	35.82
Float Memory Bandwidth B/F AVX/128 (GBps)	36.4	36.58
Cinebench 15 (Points)	991	1,096
POV-Ray 3.7 (Pxps)	2,143.75	2,322
Sniper Elite 4 (Vsync Off, Ultra, DX11)	156.51fps	147.05fps
The Witcher 3 (Vsync off, Unl.fps, Ultra)	120.85fps	127.36fps

Specs: Clock speed: 4.3GHz (base), 4.5GHz (Turbo); 4-cores; unlocked multiplier; dual-channel DDR4-2666 memory; 16 PCIe lanes; 8MB Intel Smart Cache; Hyper-Threading; Turbo Boost; 14nm; 112W TDP

Test System Specs: Motherboard: MSI X299 Gaming M7 ACK; GPU: EVGA GeForce GTX 1080 Ti FTW3; Memory: 32GB Corsair Vengeance LED DDR4-3200; Storage: 480GB Patriot Hellfire PCIe SSD; OS: Windows 10 Enterprise



Ostrog Lite
\$49.99
ENERMAX
www.enermaxusa.com

ENERMAX Ostrog Lite

ENERMAX's Ostrog line of mid-tower PC cases includes several main variants, including the Ostrog, the Ostrog GT, and the Ostrog ADV; each comes in at least two color combinations (the Ostrog ADV comes in black and red, black and green, or black and blue). The Ostrog GT is the most ostentatious of the bunch, with highly detailed sculpting on its front panel and front-end bezel, while the original Ostrog has the simplest design—or did, until the arrival of the newest Ostrog, the Ostrog Lite.

Ostrog Lite most closely resembles the Ostrog ADV in terms of its proportions and general design, but replaces the mesh and LED fans that dominate the bottom half or so of the ADV's front panel with a smooth, understated front panel with what ENERMAX calls a "hairline surface." It most closely resembles brushed aluminum, and it's a pretty good look for this case, which is pretty restrained stylistically all the way around, the only exception being the pre-installed 120mm red LED fan in the rear.

The Ostrog Lite has an acrylic side-panel window on the left panel and a solid steel panel on its right side; the top panel has ventilated mounting points for a pair of 120mm fans and a dust filter over the mesh that is held lightly in place by magnets. The motherboard tray inside is well-equipped with cable management slots and tie-down anchors, and supports ATX, Mini-ITX, and MicroATX motherboards, as well as up to two 2.5-inch drives (on the inside facing left). The case includes two bays for 5.25-inch drives up top, but there's no bulky cage up there, and you can take the support that is there out by removing a couple screws; this leaves the interior open and tidy, as the 3.5-inch drive bays are located behind the included power supply shroud.

One point of interest that we've not seen before: ENERMAX puts an 80mm/90mm fan mounting spot just beneath the front of the shroud along with the necessary ventilation. You can only install a fan there if you remove the top 3.5-inch drive tray in the bay below,

but it should help to provide a little extra airflow beneath the shroud. Alternatively, it would provide a pretty nice mounting spot for a reservoir if you decide to go custom with your cooling.

While we're on the topic of airflow, ventilation up front is limited to a little over 3/4ths of an inch of mesh at the bottom of the front panel, as the rest of the panel is closed tight despite the appearance of a gap around a panel inset. You can mount two fans up front, though, so they'll be pulling as much air as possible through that bottom gap; it might make sense to use your (optional) top-mounted fans to intake, as well, depending on what else you're doing inside.

ENERMAX's Ostrog Lite doesn't do anything too fancy, but it's a nice-looking case with a PSU shroud and a fair degree of flexibility inside for drives and cooling. And with an MSRP of just \$49.99, the price is right, too. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 18.1 x 7.6 x 17.3 inches (HxWxD); Materials: steel, plastic; Motherboard support: Mini-ITX, mATX, ATX; Drive bays: 2 x 5.25-inch external, 2 x 2.5-/3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 1 x 120mm front, 1 x 120mm LED rear; Fans (optional): 2 x 120mm front, 2 x 120mm top, 1 x 80mm/90mm under PSU shroud w/HDD cage removed; Ports: 1 x USB 3.0, 2 x USB 2.0, audio I/O

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT



Orbit-Z1
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www.rosewill.com

Rosewill Orbit-Z1

If you look over Rosewill's case lineup, you'll see lots of cases that come with pre-installed LED fans, but until the company launched its new Orbit-Z1, there were none with LEDs built into the chassis itself. The Orbit-Z1 remedies this issue nicely. It ships with two pre-installed seven-color 120mm LED fans (rear and top installation), has a series of RGB LEDs that run along the power supply shroud below the window line of the left-side panel, and has a front panel with an RGB LED strip running all the way around its edges and another that runs along it from top to bottom.

All of these LEDs are connected to a tiny light control board mounted behind the motherboard tray, and thus are all synced and slaved to the LED button at the front of the top panel. When you power up the case, all the lights flash quickly through a looped series of seven bright colors; each press of the LED button switches the lights

to a different mode, including several modes that are just always-on single-color settings, one that turns all LEDs off, and so on.

One other note about the front panel: although it has a solid front and closed sides, it extends beyond the front of the frame by about three-quarters of an inch and is open at the top and bottom, providing lots of ventilation for front-panel fans, should you decide to install one or two. The front panel is also a good spot for a 240mm radiator if that's how you roll. Otherwise, ventilation is pretty standard, including a single-fan vent set into the top panel (with a magnetically secured dust filter) and the usual mesh in the bottom and rear panels.

Elsewhere, the Orbit-Z1 is configured for the kinds of clean interiors that are popular these days, with its 3.5-inch drive bays hidden behind the power supply shroud toward the front of the chassis, a couple vertical SSD mounting spots on the mobo tray, and no 5.25-inch drive

bays. (There are vestigial spots at the front of the frame and on the right side for 5.25-inch bays, for some reason, but there's no way for an optical drive tray to open to the front.) Graphics cards up to nearly 15 inches long are supported, as are CPU coolers a little over 6 inches tall. The power supply shroud includes a couple cable routing holes, some extra ventilation, and two 120mm fan mounts.

The Rosewill Orbit-Z1 is a pretty straightforward case in terms of its dimensions and features, except of course for its big-time LED integration, which is especially interesting for a case at this price. (MSRP is \$99.99, but Rosewill tells us it will be available online for \$69.99.) If you're looking for a case that complements the lights on your components but want to avoid breaking the bank, this might be the one for you. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 17.72 x 7.8 x 17.52 inches (HxWxD); Materials: steel, plastic; Motherboard support: mATX, ATX; Drive bays: 2 x 2.5-/3.5-inch internal, 2 x 2.5-inch internal; Fans (included): 1 x 120mm LED top, 1 x 120mm LED rear; Fans (optional): 2 x 120mm front, 1 x 140mm top, 2 x 120mm on PSU shroud; Ports: 2 x USB 3.0, 1 x USB 2.0, audio I/O

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

**EAG001 Air Guide**

\$19.99

ENERMAX

www.enermaxusa.com

ENERMAX EAG001 Air Guide

Case manufacturers have made strides in recent years to improve airflow with modular bays and other customizable internals. But despite the greater flexibility, fan placement isn't always ideal, especially if your system includes long radiators, big reservoirs, and hulking graphics cards that may block airflow and create hot spots. ENERMAX's new EAG001 Air Guide is a simple way to tweak airflow and more effectively direct air to, or around, the hardware in your system. The 120mm plastic frame boasts angled vents and a rotatable grill, so you can route cool air where it needs to go.

ENERMAX includes two Air Guides in each package. And installing both, in most cases, should take less than a minute. ENERMAX provides magnetic mounting pins to quickly attach the Air Guide to a 120mm fan's existing mounting screws. For situations where the fan is mounted from behind, such as some rear exhaust fans, ENERMAX

also includes eight metal screws that you can install into the fan mounts. In our experience, the magnetic hold is strong enough that you can rotate the grill without any wiggle to the Air Guide.

To match the color scheme of your

"ENERMAX's new EAG001 is a simple way to tweak airflow...."

build, ENERMAX offers the Air Guide in a few different color options. There are all-white and all-black versions, as well as red and black or green and black options. With the color combos, the grill is red or green, while the frame is black on both models.

The Air Guide can be used with any 120mm fan, but there are some places where two guides would be best used,

in our opinion. A case's front panel intake fans, for example, are often positioned near the bottom of the case and don't often push air directly over the motherboard. You could position one of the guides to direct cool air onto a GPU, while the second could route air to your system memory and motherboard. Another excellent use is a system where an air cooler isn't lined up with the case's rear exhaust and you need to direct hot air from the CPU cooler out the PC.

ENERMAX prices the EAG001 Air Guide at \$19.99, which might be a bit pricy considering the kit's basic functionality. That being said, if your system has a few hot zones, the two Air Guides are much cheaper solution than replacing your case or completely revamping your cooling. ■

BY NATHAN LAKE

Specs: Dimensions: 120mm x 120mm x 16.5mm; Colors: black, white, red/black, green/black

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

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**Ryzen 3 1300X**

\$129

AMD

www.amd.com

AMD Ryzen 3 1300X

The Ryzen 3 1300X, and its lower-clocked sibling the Ryzen 3 1200, are the first Summit Ridge-based processors in the Ryzen family to have SMT (simultaneous multithreading) disabled. Like the bottom of the Ryzen 5 stack, these two processors feature a 2+2 CCX (Compute Complex) configuration, which means that there are still two quad-core CCX blocks on the die, but half of the cores of each CCX module have been disabled, leaving us with four functional cores on an Infinity Fabric interface.

Just like every other Ryzen processor we've covered, this 192mm² die consisting of 4.8 billion transistors is manufactured on Global Foundry's 14nm FinFET process. This processor has 512KB per core L2 cache and 8MB of shared L3 cache. The core clocks are rather interesting on the Ryzen 3 1300X. The base clock is 3.5GHz, but the chip supports an all-core Precision Boost clock up to 3.6GHz. Two cores can go 100MHz faster when there's enough thermal capacity, and AMD's Extended Frequency Range (XFR) Technology will give this processor an extra 200MHz to run with when possible. In addition to the impressive XFR number, this processor is unlocked for fast and easy overclocking.

The Ryzen 3 1300X is a 65-watt TDP processor that comes with the same Wraith Stealth CPU cooler as the entry-level Ryzen 5 processor. The Wraith Stealth is a low-profile cooler made of aluminum, and because it lacks the

copper core of the 95-watt-capable Wraith Spire CPU cooler, overclockers should keep a close eye on their temperatures when overclocking with it, or better yet, upgrade to an aftermarket cooler. When overclocking the Ryzen 3 1300X, using a custom-built liquid cooling loop, we managed to achieve a 3.9GHz core clock with the core voltage to 1.25V, giving us a decent bump in the benchmark scores.

The Ryzen 3 1300X includes an onboard dual-channel DDR4 memory controller supporting 2,666MHz speeds, but given the right motherboard and memory combination, you should be able to achieve 3,200MHz or better. We were short on time, so we weren't able to get our MSI X370 XPOWER GAMING TITANIUM to run either of the DDR4 kits we tried above 2,133MHz. Even so, this processor posted scores that in many cases, were very close to that of the Ryzen 5 1400, which just goes to show you that SMT still falls flat with some lightly-threaded workloads.

We can't recommend this processor, or the even more hobbled Ryzen 3 1200, to anyone who does a significant amount of multitasking, streaming, encoding, or other productivity work. When it comes to building a budget gaming rig, however, this is probably one of the most affordable options available that lets you devote the lion's share of your cash to a discrete graphics card. ■

BY ANDREW LEIBMAN

	Ryzen 3 1300X (3.9GHz OC)
3DMark Fire Strike Ext.	11,076 (11,377)
Graphics Score	14,010 (13,984)
Physics Score	7,956 (8,553)
Graphics Test 1	74.01fps (73.94fps)
Graphics Test 2	51.76fps (51.63fps)
Physics Test	25.26fps (27.15fps)
Combined Test	26fps (27.82fps)
PCMark 8 Creative Score	5,337 (5,558)
Sandra 2016 Lite	
Dhrystone Integer Native AVX2 (GIPS)	131.4 (141.33)
Whetstone Single-float Native AVX (GFLOPS)	62.43 (67.86)
x32 Multi-Media Integer AVX2 (Mpixels per second)	195.77 (205.22)
x16 Multi-Media Long-int AVX2 (Mpixels per second)	69 (74)
x1 Multi-Media Quad ALU (Mpixels per second)	1 (1.15)
x16 Multi-Media Single-float FMA (Mpixels per second)	213.72 (229.52)
Integer Memory Bandwidth B/F AVX/128 (GBps)	26.42 (26.35)
Float Memory Bandwidth B/F AVX/128 (GBps)	26.67 (26.63)
Cinebench 15 (Points)	537 (568)
POV-Ray 3.7 (Pxps)	1,336.3 (1,442.8)
Sniper Elite 4 (Vsync Off, Ultra, DX11)	103.13fps (103.38fps)
The Witcher 3 (Vsync off, Unl.fps, Ultra)	95.99fps (95.32fps)

Test System Specs: Processor: AMD Ryzen 3 1300X (3.5GHz Base, 3.6GHz quad-core P. Boost, 3.7GHz two-core P. Boost, 3.9GHz XFR); Motherboard: MSI X370 XPOWER GAMING TITANIUM; Graphics Card: GIGABYTE AORUS GTX 1080 Ti; RAM: Corsair LPX DDR4-3000 (clocked at 2,133MHz); Storage: 240GB Kingston HyperX SSD; OS: Windows 10 Enterprise 64-bit

CPU RANKING 0 = ABSOLUTELY WORTHLESS 2.5 = ABSOLUTELY AVERAGE 5 = ABSOLUTELY PERFECT

Aerocool P7-F12 Pro

Sync Up Your Rig's RGB Lighting

The explosion of RGB LEDs has led to jumble of different control mechanisms for the various RGB light strips, fans, and components available. The diverse set of controls, from custom software utilities to remote controls and hubs, can make syncing up system lighting and effects a complex task. Motherboard makers have tried to simplify the process with onboard 4-pin extension

can purchase additional P7-H1 hubs. (Up to eight P7-H1 hubs can connect to a single motherboard.) The P7-H1 also serves as a fan hub for up to five fans and has a 4-pin PWM connector to extend the PWM signal from the motherboard.

The included P7-F12 RGB fans don't necessarily need to connect to the P7-H1 hub to synchronize RGB color. You could, for instance, connect

on the PC and download Aerocool's P7-S1 software utility. When selecting a color, Aerocool lets you enter a hex color code or numerical RGB color spaces. For instance, those wanting a true blue color could enter Hex number 0073cf or 0/115/207 into the respective R/G/B fields. There's also a color wheel where you can drag the mouse over the hue you prefer. We prefer the numerical data entry over



The P7-H1 features two RGB headers and five 3-pin/4-pin fan headers.



The small hub can be easily stored behind a case's motherboard tray.



RGB fan illumination allows you to quickly match the colors of a build.

headers and control software, but many motherboards only include one 4-pin RGB header—limiting potential teamwork. Aerocool's (www.aerocool.us) P7-F12 Pro is a kit that comes with a hub and three Aerocool P7-F12 RGB Fans; it greatly simplifies the synchronization of your RGB devices.

Get Connected

Aerocool's P7-H1 hub features two 4-pin RGB headers and connects to your motherboard via a USB 2.0 port to synchronize lighting for two products with the 4-pin RGB connectors. If you need to sync more RGB devices, you

the fans directly to a motherboard's 4-pin RGB header to free up to hub's two RGB headers for other devices. Smartly, Aerocool lets you daisy chain the P7-F12 fans (each fan boasts a male and female RGB 4-pin connector), so the three fans only require a single RGB header.

Take Control

Once the hub, fans, and other RGB devices are connected, you can turn

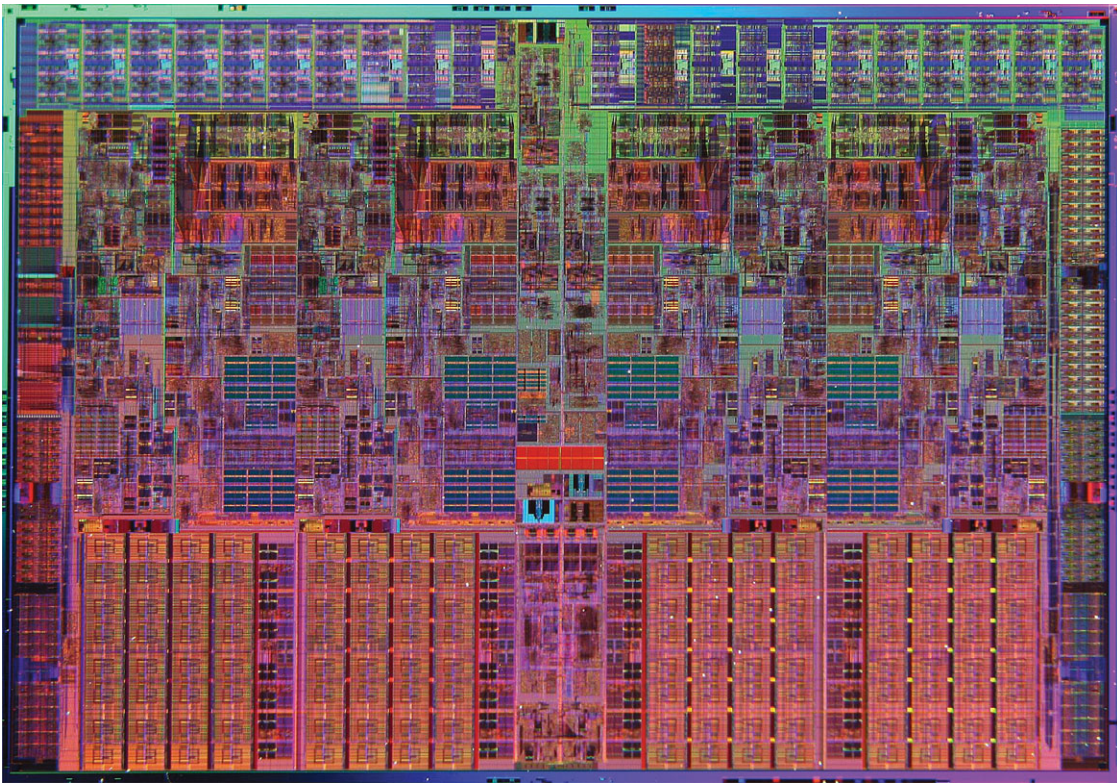
the color wheel, as it simplifies the process of perfectly matching up RGB colors with other components. The P7-S1 utility also displays the current fan speed of connected fans.

Let There Be Light

The P7-H1 hub should work with virtually any RGB device (including, say, RGB LED light strips) equipped with a 4-pin RGB connector, as it supports up to 24 watts of LED output. Best of all, the entire P7-F12 Pro kit only costs \$59.99, so it's an affordable way to add to—and take control of—your system's lighting. ■

State-Of-The-Art Standards

Intel Turbo Boost Technology



Intel's Nehalem processors were the first to sport Turbo Boost Technology.

Turbo Boost Technology is the automatic and effortless clock speed-ramping tech inside select Intel processors from every architecture between Nehalem and the recently launched Skylake-X and Kaby Lake-X processors. We all know what Turbo Boost does, and we all know why we want it enabled on our enthusiast processors (faster = better), but because it has been around for so long, we rarely take the time to delve deeper and examine how Turbo Boost works and why it's so effective when enabled on modern-day processors from Intel.

The Multi-core Conundrum

Before the dawn of parallel computing, back when the only processors available were single-core, think 2005 and earlier, all software looked effectively the same to the processor, as a series of complex or simple program instructions. There was no multi-threading, just a series of tasks getting in line one after another, and processors got faster generation-on-generation only by arranging the tasks more intelligently, or through sheer brute force, enabled through higher and higher clock speeds.

Both Intel and AMD (and IBM before them) saw the writing on that wall and realized that winning the clock speed race was a losing proposition, resulting in higher and higher power requirements without delivering enough of a performance advantage to justify the cost. The future of microprocessors would be multi-core.

In a perfect world, software running on a multi-core processor would split its tasks into as many individual threads as there are cores on the processor, and as a result, the processor would execute the series



Turbo Boost can be disabled from the BIOS, which is sometimes necessary for overclocking.

of program instructions in parallel until complete. In this fantasy realm, a task that used to take a single-core processor an hour to complete would complete in 30 minutes on a dual-core processor, or 15 minutes on a quad-core processor. We all know that we don't live in a perfect world, however, and the expected performance doesn't scale linearly with the core count, doubling in a dual-core processor, or quadrupling in a quad-core processor.

This diminishing return is described by Amdahl's law. Given a fixed workload, this law states that the expected theoretical speedup in latency of a multi-core processor is limited by the time it takes to execute any non-parallel tasks. For instance, let's say we're working on a 4K video that takes eight hours to encode on a single core processor. When running that encoding task on a multi-core processor, there is a part of the process that cannot be parallelized, which takes one hour, meaning that the remaining threads, regardless of how many cores are available to execute it, cannot complete the whole task faster than the time it takes to execute that unthreaded task. In short,

multi-core processors work extremely well with highly parallelized software, but fall rather flat when running single or lightly-threaded workloads. In the early days of multi-core processors, software was generally not parallel in nature.

The Turbo Boost Band-Aid

In 2008, Intel's engineers were faced with a growing stack of processors that used two and four cores, but lightly-threaded software wasn't exactly becoming multi-threaded overnight. This meant that most of the software users were running on these early multi-cores were punishing just one of the processor's cores a majority of the time while leaving the rest idle. Turbo Boost Technology was born as a way to reappropriate this excess of available processing power, enabling the core that's working hardest to increase its clock speed dynamically, as needed.

To use a car analogy straight out of a Subaru ad from the mid-'90s, Turbo Boost is like the differential in an all-wheel-drive car, transferring power from the wheels that slip to the wheels that grip. In the case of multi-core processors, idle cores

are about as effective as slipping wheels on a car; they'll get you nowhere fast. With Turbo Boost enabled, the processor's performance will slip a little less often.

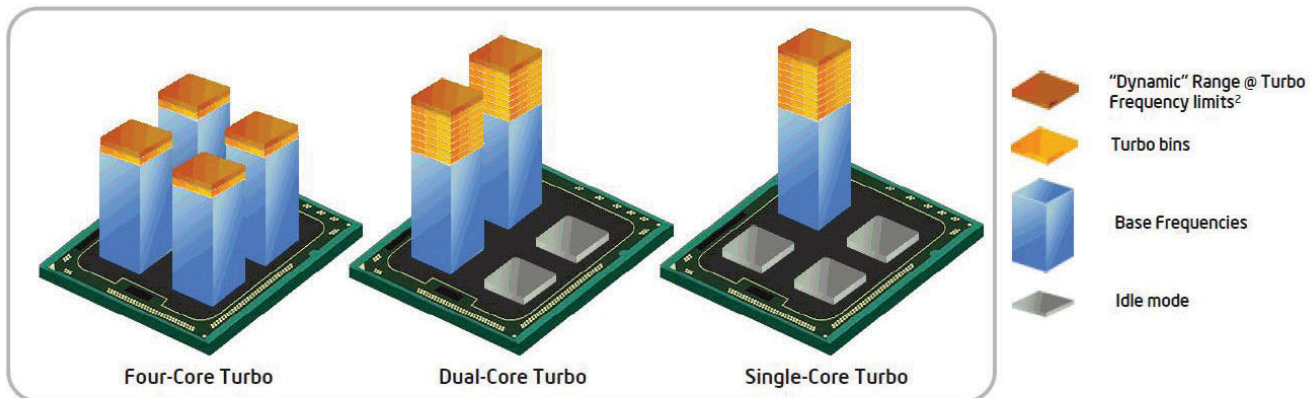
The First Turbos

The first processor to come with Turbo Boost Technology was an LGA 1366-socketed Bloomfield enthusiast desktop processor that launched in November 2008: the \$999 Intel Core i7-965 Extreme. The 2.93GHz Intel Core i7-940 and 2.66GHz Core i7-920 also launched at the same time, but still targeted the high-end desktop market. The more budget-friendly Lynnfield Core i7 and Core i5 processors that launched in September 2009 brought Turbo Boost Technology to the masses, starting at a mere \$196 for the dual-core 2.66GHz Intel Core i5-750.

According to Intel's Turbo Boost Technology whitepaper, dated to coincide with the launch of the flagship Nehalem processor, the technology can boost performance with any number of cores or logical processors enabled and active, resulting in better multi-threaded and single-threaded workload performance. Even in its first iteration, Intel designed the feature to be OS agnostic. As long as the OS in question supports ACPI (Advanced Configuration and Power Interface), the feature will work automatically and it'll be transparent to the end user. ACPI is an open standard that lets the OS perform power management functions for various hardware components, including putting them to sleep and monitoring each device's moment-to-moment status. The first ACPI-compliant OS was Windows 98, but it was hampered by buggy early-ACPI hardware. ACPI improved in successive versions, as other OSes joined the party, including FreeBSD, NetBSD, OpenBSD, OpenVMS, and Solaris to name several. Linux kernel version 2.6.0 and onward also support ACPI by default.

According to Intel, the highest increase a processor will get when Turbo Boost engages is dependent upon the number of active cores and can vary from model number to model number. Furthermore,

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The fewer active cores there are, the higher the Turbo Boost frequency multiplier will be.

the amount of time the processor remains boosted depends on the operating environment and the tasks at hand. For this to work properly, the processor needs to continually measure temperature, current draw, and power consumption in order to make the headroom estimates that allow Turbo Boost to maintain clock speeds that are higher than the base clock. Bridging the gap between the ACPI-compliant OS and Intel's new processors is the Turbo Boost controller, which is capable of checking in up to 200 times per second to determine if there's a need for Turbo Boost to shift into high gear.

Turbo Boost was also designed to be flexible enough that users with the appropriate switches in the BIOS could turn it off if need be. Overclocking those early chips often involved disabling Turbo Boost, as it was effectively made

redundant with even a modest increase in operating frequency.

Like Clockwork

Running at a higher core frequency sounds good on paper, but any mildly experienced overclocker knows that not every workload is the same and that there are a variety of ways to stress a processor. It turns out that there are plenty of reasons that Turbo Boost will disengage itself to prevent the processor from consuming too much power or generating too much heat. If everything else is equal but a Turbo Boosted workload begins to push the temperature near the TJMax (Thermal Junction Max, the highest operating temperature the cores can run at before throttling occurs), Turbo Boost automatically drops the frequency back to the base clock. For instance, Prime95's small FFT (Fast Fourier

Transform) algorithm calculations, which fill the L2 cache without spilling into system memory, are known to have particularly strong impact on temperature. Another Turbo Boosted workload, Prime95's In-place Large FFTs, ropes in system memory, which results in higher power consumption from the CPU. This is yet another scenario where Turbo Boost disengages on demand, even if the temperatures are still well within acceptable ranges.

As long as power delivery limits are maintained, a Turbo Boost-capable processor will be able to enjoy the increase in clock speed until one or more of the following occur: the estimated current consumption of the processor increases beyond preset limits, the estimated power consumption of the processor increases beyond preset limits, or the temperature of the processor hits the aforementioned

TJMax. As a side note, you can eliminate (or dramatically reduce) the times that temperature becomes the reason Turbo Boost backs off by installing a quality CPU cooler with significantly more thermal capacity than your processor typically calls for. A fourth reason Turbo Boost gets shut off is simply when all cores of the processor go idle. While Turbo Boost is a bit like overclocking, the big takeaway is that it only engages and continues to function as long as the

a numeric C state, shorthand for CPU power state, depending on what it's doing at the moment. These C states are hardwired into the processor, and some processors have more C states than others. For instance, Intel's Haswell-based processors also include package states, for up to a total of 10 possible C state settings.

According to Intel, an active core is one with a C0 or C1 state, which refers to cores that are either currently operating to execute threads or in a halt state but ready

supported levels of the Sleep state, including Deep Sleep and Deeper Sleep, but for the purposes of Turbo Boost, anything greater than C3 or C6 is considered inactive.

Calculating The Boost

Because Turbo Boost has been around for so long, with three updates since its initial launch and the latest Skylake-X and Kaby Lake-X processors, it doesn't always work the same. The Nehalem and Westmere architecture-based processors use 133MHz



Turbo Boost Max Technology 3.0 lets the best-performing core run considerably faster than all the rest.

processor remains safely within its design specifications.

The C-State Connection

We mentioned previously that the number of active cores has an effect on whether Turbo Boost engages, but we didn't actually define what qualifies as "active." The operating system assigns each core of a multi-core processor with

to receive threads without delay, respectively. The C2 or "Stop Clock" state is optionally supported on processors, but it refers to a state where the core maintains visibility to the software but will only be available to field threads after a short delay. C3 is a widely supported C state that's referred to as the "Sleep" state. The caches of a processor core in a C3 state are no longer coherent. There are multiple optionally

Turbo Boost steps (the clock speed increment at which the cores increase). Sandy Bridge, Ivy Bridge, Haswell, Broadwell, Skylake, and Kaby Lake processors all use nice, round 100MHz Turbo Boost steps.

Each Turbo Boost-enabled processor comes with a multi-digit Max Intel Turbo Boost Technology "bin upside" number that looks something like this: 3/3/3/3/5/5. That's the bin upside number for the

Haswell-E Intel Core i7-5960X, which refer to the various Turbo Boost multipliers as they correspond to active cores. This is an eight-core processor, and that first digit refers to the Turbo Boost multiplier when six-to-eight cores are active, times Haswell's 100MHz steps, which equals a max Turbo Boost frequency increase, assuming there's enough headroom, of 300MHz. The second number refers to the multiplier for five active cores, followed by the multiplier for four and three active cores. As you can see, Turbo Boost on this processor doesn't go above 300MHz until just one or two cores are active, and then it bumps the frequency up by a multiplier of five, for 500MHz.

Mobile processors that support Turbo Boost get a little more room to run. For instance, the Sandy Bridge-based Intel Core i7-2920XM has a 7/7/9/10 bin upside. Its rather low base frequency of 2.5GHz will boost to 3.2GHz when three or four cores are active (2.5GHz + 700MHz), 3.4GHz when just two cores are active (2.5GHz + 900MHz), and up to 3.5GHz when just one core is active (1GHz). Although these numbers are impressive, mobile processors have much tighter thermal and power limitations, so it's likely that Turbo Boost engages less often than on the desktop variants. Incidentally, if you're wondering why we just covered the bin upside of Haswell and earlier processors, it's because Intel stopped divulging these stats for its more recent architectures.

Before Turbo Boost, There Was ...

Intel Dynamic Acceleration, admittedly a rather un-catchy name, was a technology that Intel introduced on its Core 2-based Centrino platform. The nuts and bolts of how IDA turned on was rather simplified compared to how Turbo Boost would later function. Basically, whenever the OS told the processor to send one of the cores to a C3 sleep state, the frequency of the remaining active cores increased while still keeping the processor within its design specification.

Turbo Boost Revisions

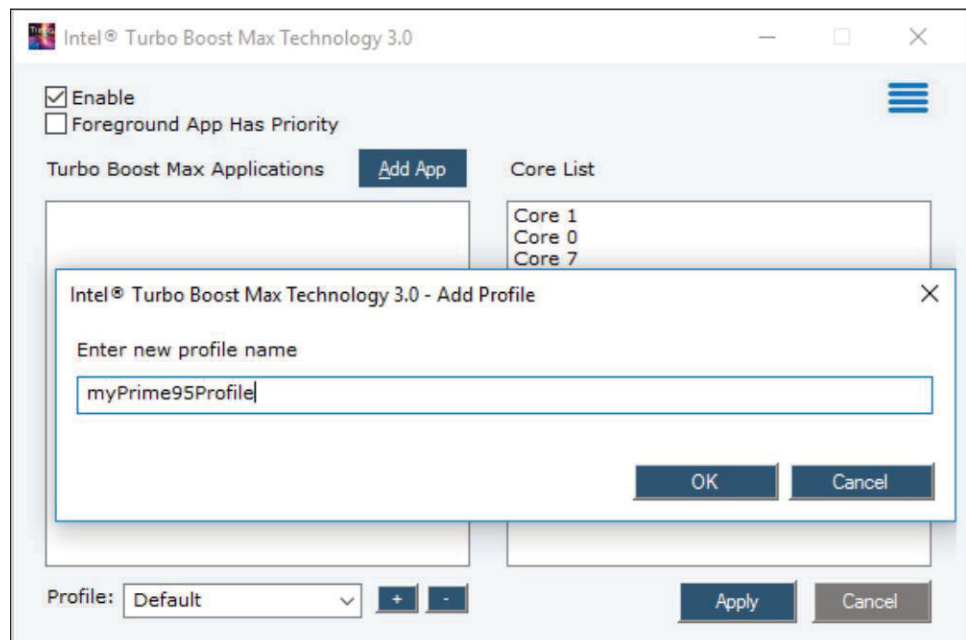
Since 2008, Intel has made a couple minor changes to Turbo Boost. In 2011, Intel launched its Turbo Boost Technology v2.0, available on Core i5 and Core i7 Sandy Bridge and later desktop processors. This update to the specification simply accounted for the new architecture consisting of integrated on-die processor and graphics.

Intel Turbo Boost Max Technology 3.0 is featured on the Intel Core i7-6950X Processor Extreme Edition, Intel Core i7-6800K, i7-6850K, i7-6900K, i9-7900X, i7-7820X processors, and the Intel Xeon Processor E5 1600 v4 family of processors. We're going to go out on a limb here and predict that the remaining HCC Skylake-X processors due to launch throughout the rest of the year will also support this technology. The big difference here is that Intel has enabled the system to determine the favored, or best core, capable of maintaining the highest operating frequency with the lowest leakage at the highest reliability. Turbo Boost Max 3.0 needs support in the BIOS, in the processor, and in the OS via a driver.

The earliest iterations of the driver needed to be manually downloaded from Intel and installed in order to enable the feature, but as of the launch of the new X-Series processors, the Intel Turbo Boost Max Technology 3.0 driver comes to your system via Windows Update. One of the coolest features of the latest revision is the Intel TBMT 3.0 Control Panel application, which lets users manually direct certain applications to run on the fastest core, effectively giving that app a higher priority than all others.

To The Max

It's not common for us to focus on a proprietary technology in the pages of State-Of-The-Art Standards, and as a result, this article lacks the usual nitty gritty details that we're typically privy to with open industry-wide standards. On the other hand, Turbo Boost definitely qualifies as a technology that yields tangible benefits for a large group of enthusiasts, which makes it a good topic nonetheless. Next month, we plan to take a closer look at AMD's automatic and algorithmic clock-speed-enhancing technology as it has evolved from its earliest form to its current state in Ryzen and Threadripper processors. ■



The Turbo Boost Max Technology 3.0 Control Panel lets you manually assign an application to the fastest core.

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Mastercase 5 Racing

Bill “Mnpctech” Owen has created a lot of great mods over the last 16 years, but he just recently finished work on a mod idea that he’s always wanted to build, and the result was this month’s Mad Reader Mod. Mastercase 5 Racing was inspired by the legendary Porsche 917 driven by Steve McQueen in a movie from 1971. “I’ve always wanted to create a build inspired by ‘Le Mans,’” Owen says. “You also don’t often see pastel colors used on custom PC builds, but this combination really works nicely.”

Owen says he will primarily use this rig for editing video and photos, and that he got deals on all of the hardware in the system by finding parts on eBay or buying them from friends who were upgrading their systems. “A lot of people get caught up in chasing the bleeding edge of tech, but if you’re patient and determined, you can build a really cool custom rig on a budget,” Owen says.

Passion Project

Owen may have saved some money on components, but he went all-out in getting the stuff he needed to bring his dream project to life. “I tracked down the factory paint codes for the 1970 Porsche 917,” Owen says. “The EK XTX 360mm radiator was painted in Gulf Racing Orange; the orange stripe is mirrored onto the chassis. The circle number five represents ‘Mastercase 5.’”

But as you have probably noticed, the automotive theme didn’t end with the paint job. “I chose one-half-inch OD

[outside diameter] stainless steel tubing, inspired by the fuel and brake lines of a race car,” Owen says. “I used 316 marine-grade stainless, so corrosion isn’t an issue. Working with stainless steel requires a mandrel bender, and it takes a great deal of practice to get perfect bends.”

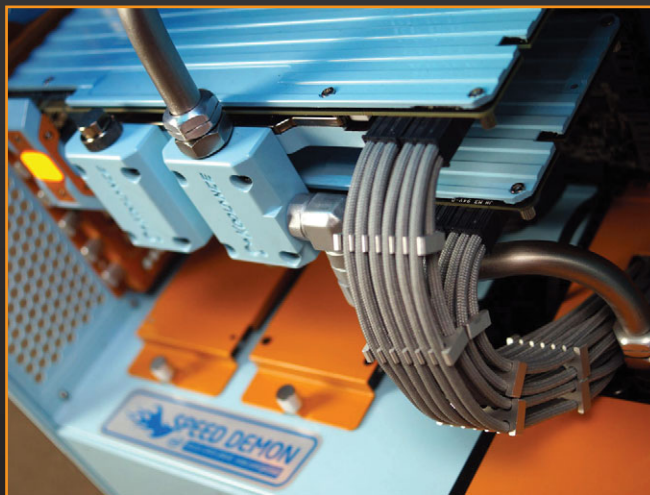
The items at the top of the front panel are also from fitting sources: “The gauge is a VDO 12-volt gauge from an old Volkswagen to indicate power,” Owen tells us. “And the main power switch is a momentary toggle switch with red safety cover that was used for the ignition switch in the Porsche 917.”

Mnpctech Parts

Other points of interest include the front grille, which Owen laser-cut from one-eighth-inch cast acrylic, the smoked acrylic “moon roof” window on the top panel, the clear acrylic side-panel window that is held in place by embedded magnets, and the 120mm ring/fan grille on top that resembles a race car’s fuel fill port. The latter three items are all Mnpctech products, as are the machined-aluminum cable combs that help keep the thick paracord PC cables (inspired by sparkplug wires) neat and tidy.

Components & Cooling

Under the hood, Mastercase 5 Racing has a laundry list of parts that provide serious performance despite not being quite as cutting-edge as they once were. The rig is powered



by an Intel Core i7-4790K mounted on a GIGABYTE GA-Z87X-OC motherboard, 32GB of Corsair Vengeance DDR3 memory, an Intel SSD 520 Series 240GB drive, twin EVGA GeForce GTX 980 Ti graphics cards in SLI, and a Corsair 800-watt PSU. The case, of course, is Cooler Master's MasterCase Maker 5.

Owen says all of the fans in the build are Scythe Gentle Typhoon AP-15 units. "Unfortunately, these cooling fans are no longer being made, but there are still some available from online retailers," he says. "They have good static pressure, and under-volt nicely. Plus they are easy to dismantle for custom painting."

Other cooling gear in the build includes a Bitspower Summit 1150 CPU block, EK motherboard blocks, an EK XTX 360mm radiator, two Koolance 980 Ti waterblocks and two Koolance backplates, Mnpctech Overkill stainless-steel hardline compression fittings, a Koolance three-way splitter fitting with drain port, and a Koolance drain valve.

More To Come

As you would expect, Owen isn't taking much time off now that Mastercase 5 Racing is complete. "I'm currently in the planning stages with Jeremy "E.E.L. Ambience" Birch to create a custom PC that will look like it came from the Nostromo spaceship in the first 'Alien' movie," Owen says.

Two of our favorite modders working on a project from one of our all-time favorite movies? Yes, please. ■

We Want Your Mod

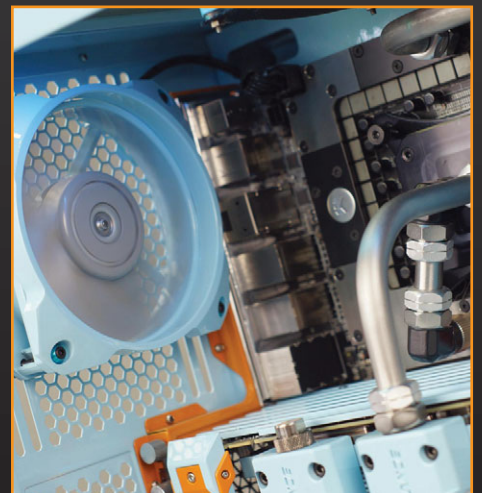
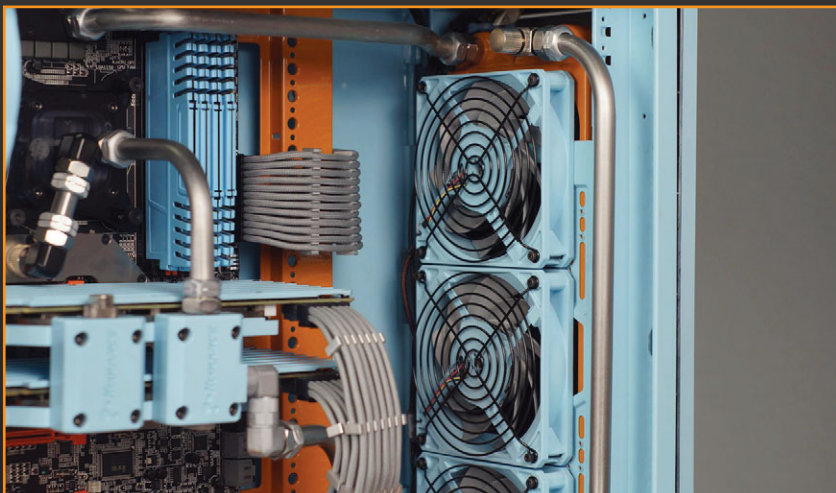
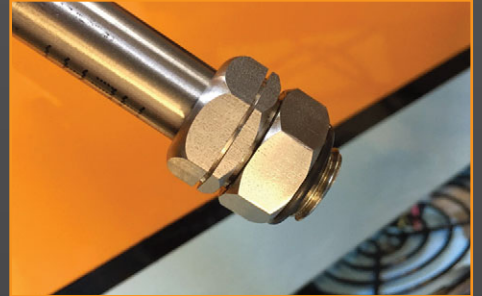
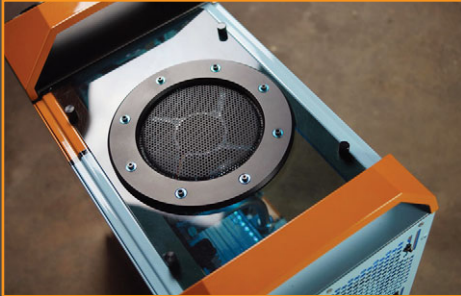
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KCGameOn 75

15 Hours Of Awesome

Back in 2005, some co-workers in the Kansas City area started gaming together on weekends. Now, 12 years have passed, and 15-person informal LANs have given way to organized events that bring in hundreds of BYOC attendees and hundreds more spectators and tabletop gamers. These events take place six times each year, and are all part of the KCGameOn series of LANs.

KCGameOn 75 took place on Saturday, June 10, from noon to 3 a.m. the next morning in North Kansas City, and *CPU* was there. Attendance for the event totaled 412, and in addition to the BYOC LAN (complete with Counter-Strike: Global Offensive, League of Legends, Overwatch, and Rocket League tournaments, of course), attendees and spectators alike spent time playing console games and tabletop games. KCGameOn events also include Hearthstone tourneys, and console fighting game tournaments, so there's something for everyone.

The event provides dinner, pop, and snacks as part of the entry fee (\$20 for BYOC, \$15 for console and tabletop, or \$25 for all), and PC rentals are available if you'd rather not haul your own rig to the LAN. (Rental rigs include Core i5-4570 processors and EVGA GeForce GTX 960 graphics cards; you can get more info at the KCGameOn site's News page.)

If you live in or near the KC metro and would like to find out more, you can check them out on Twitter ([@KCGameOn](https://twitter.com/KCGameOn)) or Facebook (www.facebook.com/KcGameOn), or visit the event site at www.kcgameon.com.



While we were at KCGameOn 75, we also got to give away some great prizes from Alphacool. Alphacool Eislicht LED panels went to 14 lucky winners, and two attendees even won Alphacool Eisbaer 120 all-in-one CPU coolers.



Mod Contest

In addition to giving away some cool prizes, we held a mod contest at the event, and our winner was Jonathan “Warboy” Imler. His rig (he calls it Ragnarok) is housed in a Phanteks Enthoo EVOLV and is tricked out with a custom hardline cooling loop and red LEDs all around.



For winning the mod contest, Imler received a GIGABYTE AORUS AX370-Gaming K7 AM4 motherboard.

In The Loop

Flip Your AIO

We all know that when it comes to cooling your CPU or GPU, water is the superior option for the high-performance parts we love to work and play with. There are two options for liquid-cooling these components, using an all-in-one liquid cooler that consists of a radiator connected by factory-sealed tubes to an integrated waterblock and pump, or using a fully custom liquid-cooling system with flexible or hardline tubing. The former are easy to install, they deliver fantastic cooling capacity for overclockers, and they're relatively inexpensive.

Plus, when compared to a custom loop, AIOs are significantly less complex and don't require occasional flushing and filling.

For these reasons and more, AIOs have become extremely popular with everyone from enthusiasts to novice PC builders. Chances are pretty good that if you're reading this, you used an AIO to cool your PC, and we're also willing to bet that you have at least considered making the jump to a fully custom loop. We spoke with Elliot Shiver, PrimoChill's Senior Technical H2O Specialist to get some expert advice on how you can recycle your current AIO to give you a head start with a custom liquid-cooling system.

Q : Is it possible to add a larger radiator to a 120mm or 240mm AIO?

ES : Yes! However, your selection should be restricted to a thin radiator with fairly low restriction, so [particularly thick or high-restriction radiators] are out; thin radiators such as the PrimoChill Eximo, Magicool low-profile, and XSPC EX radiators would be ideal. I would stick to a size of 360mm and smaller for a single AIO pump.

Q : Is it better to completely toss the integrated pump/CPU block when stripping the AIO for parts?

ES : The integrated pump/CPU block is the most valuable part of an AIO; the radiator is almost always aluminum and should be tossed if you plan on running the loop for more than a few days. The total volume of water in a system will not have much of an impact—what you should be concerned with is the volume of water the pump can flow in a given period of time. This is easy to measure by running the pump into an empty bottle of known volume and timing how long it takes to fill up.

Q : What are some of the benefits of converting an AIO into a custom loop?



Ready to say “adios” to your AIO?

ES : Many people already have an AIO, and converting it into a custom loop is fun and inexpensive. The performance is still acceptable. If a user finds it to their taste, they can venture into full custom watercooling.

Q : What are some of the drawbacks of using AIO parts in a custom loop?

ES : It is a little cumbersome and messy, and most units have barbs of a fixed size instead of G1/4-inch ports, so changing fittings isn't an option. I have sourced some fittings to convert the Asetek units from the integrated barbs to G1/4-inch fittings on the pump only (the radiator barbs



The best thing about a custom loop compared to an AIO is the wow factor.

are soldered on), but they are made from aluminum. Another issue with these adapters is that they don't fit every Asetek-based pump head, only the ones with larger-diameter tubing, such as the Corsair H100i GTX. Of course this is not an issue with units that come with G1/4-inch ports from the factory, such as the Fractal units and the purpose-made expandable AIO units like the HX2 series from Swiftech. There is a lot to consider when choosing a unit to expand; the two units on the market that do not require any serious modification or scrapping parts to expand are the Swiftech units and the Fractal Kelvin, both of which use all-copper parts and have standard threaded ports.

Q: Is galvanic corrosion something I should be concerned about when performing this conversion?

ES: Corrosion is a major issue if you are using any of the units that contain an aluminum radiator. Only a few units use copper radiators,

while they all use copper blocks. If the unit you are using has an aluminum radiator and you continue to use it in your custom loop, this is an issue. If you toss it and replace it with a copper radiator, you are good to go. When filled and sealed from the factory, these mixed aluminum and copper units have a lifespan of about two years or so, depending on frequency of use and temperature. What kills these units is typically pump failure related to increased back-pressure from accumulated corrosion on the micro fins of the CPU waterblock.

Corrosion inhibitors are not as effective as many people think, they only slow down corrosion and suspend the corrosion particles in the fluid, but that means that eventually those suspended particles accumulate in the fins of the waterblock, slowly increasing temperatures and making the pump work ever harder until it quits. Corrosion inhibitors such as sodium 2-ethylhexanoate and additives such as ethylene glycol, the much-less-toxic propylene glycol, or even glycerin only

delay the inevitable. Products that inhibit corrosion are also typically toxic and environmentally dangerous, so that is always a big consideration. I prefer water-based fluid with non-toxic and environmentally friendly additives.

Q: If I turn an AIO into a custom loop, do I need to periodically flush and refill it?

ES: This is recommended for even the highest-quality of loops with only copper and brass parts. I recommend every three to four months for specialty fluids and eight to 12 months for clear fluids. A mixed-metals AIO should be flushed every three to six months, depending on the volume total in the system, to maximize lifespan. An all-copper and brass AIO can be flushed once a year without complications.

Q: Does clear tubing have an impact on how a cooling system performs long-term?

ES: Clear tubing should not be an issue unless the system is in direct sunlight; direct UV radiation can break down fluid additives and encourages algal growth. Keep it out of the sun and clear tubing should be ok. The major difference between dedicated pumps and the AIO pumps is flow rate and pressure. The Asetek units are especially lacking, while the units such as the Fractal Kelvin and Swiftech units use scaled-down versions of dedicated pumps and are much stronger. As long as the loop only consists of one or two blocks and one or two low-restriction radiators, the Asetek unit should do fine, but the problem is bleeding air, these pumps may not have the flow rate needed to bleed all air, requiring a user to manually bleed air from the loop. A solution for this is to have another pump inline just downstream of the reservoir to bleed air, after which the pump can be deleted from the loop. ■

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Modder Q&A: Alex Quaintance

From Gaming To Modding To Starting His Own Business

Alex “FrozenQ” Quaintance is the founder and owner of FrozenQ PC Mods (frozenqpcmods.com), an online shop dedicated to PC building and modding products and services. Quaintance is also an avid, accomplished modder whose work has appeared in *CPU*’s “Mad Reader Mod” feature (November 2016) and elsewhere.

Q: When we talked to you last year for “Mad Reader Mod,” you said that Orange Nexus was your 17th mod, and that you started modding PCs in 2007 and 2008. How did you get into it in the first place?

AQ: I think it was back in 2004 when my parents bought me my first computer. It was a mid-sized HP tower, with quite mediocre and generic hardware for the time. I had just been exposed to PC gaming by my dad and some of his friends, so I was keen to try it out. Within a month I’d begged and pleaded for them to buy me a graphics card. Opening up that case to install a classic Radeon is what started it all. Wasn’t long before the motherboard and memory were replaced, followed quickly by a Thermaltake Kandalf and some disastrous liquid-cooling experiments.

Q: What was your first mod project like?

AQ: The first actual mod would have been in the aforementioned Thermaltake Kandalf. I believe it originally housed an AMD Socket 939 Athlon X2 system, which I quickly replaced with an Intel Core 2 Quad Q6600 and some original Thermaltake/Swiftech liquid cooling. Threw in some cathodes and LED fans and called it a



day! It’s actually quite embarrassing with how messy the build was.

Q: Which part of every mod project would you skip if you could, and why?

AQ: Painting. I find painting to be the most tedious and time-consuming part due to the preparation and patience it takes. More often than not in painted builds, I end up redoing several panels at least once since I’m simply never happy with them. You’ll get a little flake here or some

discoloration there. At this point in time, I much prefer working with vinyl wraps. The quality of custom printed vinyl wraps has improved so much over the last decade. For a reasonable price you can wrap a case flawlessly and transform it into a canvas with anything you want.

Q: When did you start FrozenQ PC Mods, and how did that go down?

AQ: Not afraid to admit it, but I started FrozenQ out of my



Orange Nexus, Quaintance's Mad Reader Mod-winning project. For more detailed info, see the November 2016 issue.

parents' garage in 2009. It started as one-off reservoir builds for clients online and custom builds for friends and family, but it wasn't long before I outgrew the garage and landed in a shop of my own. Like any small business, it was certainly a rocky start, but we made it work and have always been happy with the progress we've made.

Q: What kinds of modding services does the company offer?

AQ: We offer pretty much anything you can think of, and if we don't personally do it, we have close partnerships with other shops that we

source for the work. In house we do laser cutting, full custom builds, vinyl case wraps, case painting, custom watercooling gear, a variety of plastic fabrication, and more. For other things like powder-coating, cable-sleeving, and metal work, we have some amazing shops that provide this for us.

Q: The double-helix Liquid Fusion reservoirs have been a pretty big hit for your company, right? How long have you been selling those, and where'd the idea come from?

AQ: We've been making those since our start in 2009. I was looking

for ways to spice up my build at the time and make something unique for my liquid cooling system. I was a big fan of CyberDruid's work from OCN, and I set out to make my own acrylic reservoirs. The first one was literally a cylinder where the coolant flowed down a big spiral insert, almost like a screw. I took that idea, and developed that into the Liquid Fusion reservoir by making a more appealing spiral. Combined with some obvious inspiration from the T-Virus, we ended up with something similar to the Liquid Fusion reservoir we have today.

Q: Prior to Orange Nexus, we remember seeing your VaultHunter.exe mod at quite a few events and online. When did you build it, and what makes it special?

AQ: This build was a project that my brother and I worked on to showcase a concept case that we wanted to sell. We love mixing it up and doing themed builds now and again, and he is a big Borderlands fan so it seemed natural that his next build needed to be Borderlands-themed. I think the defining feature of it is the nearly 16 x 16-inch psycho etching on the window side that was illuminated with the internal lighting, but you can't forget the etching of our beloved Claptrap on the reverse side!

Q: How did you come up with the FrozenQ hex design that you incorporate into all your mods?

AQ: To be honest, I really don't know the answer to this one! I think it just started out as something I defaulted to for fan grille patterns for my early case builds. I'd always liked abstract backgrounds for my computers and always had several with some really cool hex patterns. So the hex patterns kind of stuck and became part of our branding.

Q: You mentioned last year that Orange Nexus got its inspiration in part from

the Asimov skin in Counter-Strike: GO; do you play a lot of CS:GO?

AQ : I used to play quite a bit. I joined the CS:GO craze late in the game, but probably have over 600 hours. Nowadays when I have the time, I play either Overwatch or PLAYERUNKNOWN'S BATTLEGROUNDS.

Q : Do you attend a lot of LAN events, and if so, which ones are your favorite?

AQ : I do! I try and attend as many as I can within reason. We go to a lot of the larger ones like DreamHack, but I really enjoy the smaller ones, too. My favorite has to be my "home" LAN which is the FITES 250 in central Pennsylvania held every February. To date, this LAN has the most "chill" feel of any LAN I've ever attended. It is super laid-back, held in a cozy hotel ballroom setting, and the staff and attendees are always super awesome and friendly people to spend the weekend with.

Q : It's time for Five Quick Questions!

1) Case mod or scratch build?

Scratch build, so much more creative freedom!

2) Core or Ryzen?

Core all the way.

3) AWP or M4?

Negev! (Nah . . . resident AWP'er here.)

4) Best shop music: metal or classical?

Between the two, metal, but you'll mostly find us listening to EDM.

5) Borderlands or Borderlands 2?

You know, as much as I want to say the original, I think Borderlands 2 wins here. So much more depth and some really enjoyable DLC. I think at this point, I have at least 5 playthroughs of BL2. ■



VaultHunter.exe, another FrozenQ mod, this one of course with a Borderlands-inspired theme.



Quaintance's Gravity mod.

The Chipsets, They Are A-Changin'

Thanks to a slew of new CPUs from AMD and Intel, 2017 has been a great year for PC builders.

Power users now enjoy a veritable cornucopia of budget, mid-range, and high-end CPUs based on AMD and Intel platforms. And upcoming AMD ThreadRipper and Intel Core i9 Extreme Edition chips show huge promise for performance enthusiasts. And most often, a new CPU means it's time for a new motherboard.

Ryzen & ThreadRipper

As of press time, there isn't a lot of information about Threadripper, but we do know the premium CPUs will be based on the Zen core architecture found in Ryzen processors. ThreadRipper CPUs are expected to feature a quad-channel DDR4 memory controller and a huge number of PCIe 3.0 lanes (up to 64) for exceptional memory, multi-GPU, and PCIe SSD support. AMD also plans to introduce a new socket (TM4) and the X399 chipset with Threadripper. AMD's AM4 platform and Ryzen processors are geared more toward mid-range and low-cost builds, though the Ryzen CPUs provide plenty of punch for the price point. Enthusiasts using Ryzen CPUs are most likely to plan builds around the X370 chipset because it supports SLI and CrossFire (at x8/x8). Ryzen CPUs are built with a dual-channel memory controller, as well as a four dedicated PCIe 3.0 storage lanes for a PCIe SSD. Builders on a budget might also consider boards based on the B350 chipset, which is similar to X370 but lacks support for dual-GPU setups.

Kaby Lake & Core X

Intel, as you might expect, hasn't taken AMD's resurgence in the CPU market lightly. The new Core X-Series processors feature new architecture and completely reset Team Blue's high-end lineup. The X299 chipset is what you'll need to run a Skylake-X or Kaby Lake-X CPU, and X299 is a big improvement over the aging X99 chipset. Whereas X99 had only eight PCIe 2.0 lanes, X299 brings 24 PCIe 3.0 lanes to deliver the bandwidth necessary for multiple PCIe, NVMe SSDs and additional high-end connectivity, such as USB 3.1 ports. Skylake-X processors, like Intel's Broadwell-E and Haswell-E chips, provide excellent support for multiple GPU configurations and quad-channel memory. Kaby Lake-E processors, on the other hand, are closer in design to mainstream Kaby Lake chips. With Kaby Lake-X, you're limited to a dual-channel memory controller and 16 PCIe 3.0 lanes for graphics cards. The Z270 chipset and Kaby Lake processors are only seven months old, and it speaks volumes about the PC market when this platform is the oldest of the current generation. Similar to the X299 chipset, the Z270 chipset features 24 PCIe 3.0 lanes for high-speed connectivity. The Z270 chipset supports both mainstream Kaby Lake processors and previous-generation Skylake CPUs.

Custom Touches

Modern AMD and Intel platforms give motherboard makers a fair amount of flexibility when it comes to chipset additions. In this guide, we note the most innovative and helpful amenities for power users to help you find the board that's right for your next build.

AORUS GA-Z270X-Gaming 7

\$229.99

www.aorus.com

Why You'll Dig It: The GA-Z270X-Gaming 7 is a tremendous value. It comes with serious enthusiast features, such as RAID support for triple PCIe SSDs and DDR4 kits at up to 4,133MHz, at the cost (\$229.99) of a mid-range Z270 motherboard. GIGABYTE also provides an abundance of RGB LEDs, which can be split into multiple zones, for gorgeous, custom illumination. The motherboard also supports RGB, RGBW, and RGB/UV light strips via an RGBW pin header to let you sync third-party RGB LED strips. Gamers will also like that GIGABYTE includes Creative's Sound Core3D quad-core audio processor, as well as Creative's SBX Pro Studio suite where you can tailor sound quality. To make overclocking easier, the mainboard includes clear CMOS, power, and reset buttons, as well as voltage measurement points.

Who Should Apply: Power users who want premium motherboard features—without the luxury price tag.

Socket: LGA 1151

Expansion slots: 3 PCIe 3.0 x16, 3 PCIe x1

Maximum memory support: 64GB DDR4-4133



ASRock Z270 Extreme4

\$164.99

www.asrock.com

Why You'll Dig It: The Z270 Extreme4 is an affordable mainboard with an abundance of power user amenities. There are two 32Gbps M.2 ports, an M.2 Key E port for a wireless module (not included), a 10-phase digital power design, and two USB 3.1 ports (one Type-A and one Type-C). The latter is powered by an ASMedia 2142 chip that supports up to 16Gbps of bandwidth, so each USB 3.1 port can still operate at up to 8Gbps when both USB 3.1 ports are active. The Z270 Extreme4 is also visually interesting with a white "X" silkscreen across the PCB and heatsinks. ASRock installs RGB LEDs into the rear I/O cover, the audio circuitry cover, and the PCH heatsink. There's also an AURA RGB LED header that syncs board lighting with an LED strip or other 4-pin RGB hardware.

Who Should Apply: System creators who are looking for a full-featured Z270 motherboard at an attractive price.

Socket: LGA 1151

Expansion slots: 3 PCIe 3.0 x16, 3 PCIe 3.0 x1

Maximum memory support: 64GB DDR4-3866



ASRock X370 Taichi

\$209.99

www.asrock.com

Why You'll Dig It: ASRock does an outstanding job of balancing performance, connectivity, and cost on the X370 Taichi. For 209.99, the mainboard features 12+4-phase power delivery, an external base clock generator, two M.2 ports, and onboard 802.11ac Wi-Fi. We give the X370 Taichi style points, as well, thanks to the white and black clockwork theme that runs through the PCB and heatsinks. ASRock's Hyper BCLK Engine II serves as the base clock generator and allows for BCLK up to 136MHz. Impressively, ASRock rates the board for up to 300-watt TDP overlocks. We like that ASRock provides two slots' worth of space between the two PCIe 3.0 x16 slots, as the layout is ideal for airflow with two GPUs. There are two M.2 slots, and the top M.2 slot is where you'll want to install your high-speed storage devices, because it has access to four PCIe 3.0 lanes. SATA connectivity is generous with a total of 10 6Gbps SATA ports.

Who Should Apply: Overclockers who want a high-end X370 motherboard that's priced close to \$200.

Socket: AMD AM4

Expansion slots: 2 PCIe 3.0 x16, 1 PCIe 2.0 x16, 2 PCIe 2.0 x1

Maximum memory support: 64GB DDR4 DDR4-3200



ASUS ROG CROSSHAIR VI HERO

\$254.99

www.asus.com

Why You'll Dig It: The ROG CROSSHAIR VI HERO is one of the best motherboards for AMD's X370 chipset. It's a particularly interesting option for builders using liquid cooling. The board features a Water-Cooling Zone with two water temperature sensors and a flow-rate header that sends data to ROG's Fan Xpert 4 utility. The water temperature sensors allow you to monitor water temperature at the input or output of any component. We also like that ASUS designs the ROG CROSSHAIR VI HERO to support both AM3 and AM4 CPU coolers, so you can use an existing AM3 cooler. ASUS adds its Pro Clock technology, which enhances the board's voltage and base-clock overclocking options. The ROG CROSSHAIR VI HERO stands out inside a case, thanks to the Aura Sync RGB LEDs, and ASUS includes two 4-pin headers that can sync up lighting with RGB LED strips.

Who Should Apply: Builders who want a motherboard with exceptional onboard tools to maximize Ryzen performance.

Socket: AMD AM4

Expansion slots: 2 PCIe 3.0 x16, 1 PCIe 2.0 x16, 3 PCIe 2.0 x1

Maximum memory support: 64GB DDR4-3200



MSI Z270 GAMING M7

\$249.99

us.msi.com

Why You'll Dig It: The Z270 GAMING M7 is designed to get the most out of PCIe, NVMe SSDs. There are three 32Gbps M.2 slots and a U.2 port. You can connect up to three PCIe SSDs in RAID 0 via MSI's M.2 GENIE feature, and we also like that M.2 GENIE makes it easy to create the RAID configuration. MSI also includes several tools to improve the gaming experience. The Gaming Hotkey utility, for instance, allows you to set up macros, assign commands, and create profiles to customize the functionality of any keyboard. To customize your mouse, MSI also includes a Mouse Master utility where you adjust mouse DPI and program macros to mouse buttons. To take advantage of the mouse and keyboard upgrades, just connect your gaming peripherals to the GAMING Device ports (1 PS/2, two USB 2.0) at the top of the rear I/O panel.

Who Should Apply: Gamers who want to minimize load times with a blazing, RAID 0 set of PCIe SSDs. It's also a good option for gamers who want to customize keystrokes and mouse functions.

Socket: LGA 1151

Expansion slots: 3 PCIe 3.0 x16, 3 PCIe 3.0 x1

Maximum memory support: 64GB DDR4-4133



EVGA X299 Micro

\$269.99

www.evga.com

Why You'll Dig It: Just because a build is small form factor doesn't mean you have to sacrifice performance. EVGA's X299 Micro is a microATX motherboard built for Intel's new Core-X Series processors, and it can also support up to two 2-way SLI and CrossFire configurations. The motherboard also sports four DIMM slots, and you can install quad-channel kits up to 3600MHz, assuming you use a Skylake-X processor. A Kaby Lake-X chip, by comparison, can only access two of the DIMM slots. For overclocking stability, EVGA designs the board with 12-phase digital VRM and an 8-layer PCB. EVGA also manages to fit onboard power, reset, and clear CMOS buttons for convenient overclocking. Storage and I/O options are comparatively robust for the microATX form factor. There's an M.2 port, a U.2 port, and six 6Gbps SATA ports.

Who Should Apply: System creators who are looking for a full-featured X299 motherboard in the microATX form factor.

Socket: LGA 2066

Expansion slots: 3 PCIe 3.0 x16

Maximum memory support: 64GB DDR4-3600 (Skylake-X)
or 32GB DDR4-4100 (Kaby Lake-X)



Supermicro C7Z270-PG

\$339

www.supero.com

Why You'll Dig It: Supermicro's C7Z270-PG boasts Broadcom's PEX8747 chip that ups the PCIe graphics lane count to 32—up from 16 on a Skylake or Kaby Lake processor. With the extra lanes, the C7Z270-PG runs 2-way GPU setups at x16/x16, 3-way at x8/x8/x8, and 4-way configs at x8/x8/x8/x8. You can also build an incredibly fast RAID 0 configuration with PCIe SSDs using either the two M.2 slots (both offer support for type 2260/2280/22110 devices) or the two U.2 ports. RAID 1 configuration for data mirroring is possible, as well. Keeping with the multiplex theme, the C7Z270-PG comes with two Ethernet ports powered by Intel i219V and i210AT NICs. The two LAN ports can work together via teaming to deliver bandwidth up to 2Gbps, or you can connect to two private networks at one time.

Who Should Apply: Power users with two or more graphics cards who want to get the most out of their multi-GPU configuration.

Socket: LGA 1151

Expansion slots: 4 PCIe 3.0 x16, 1 PCIe x4

Maximum memory support: 64GB DDR4-3733



MSI B350 TOMAHAWK ARCTIC

\$119.99

us.msi.com

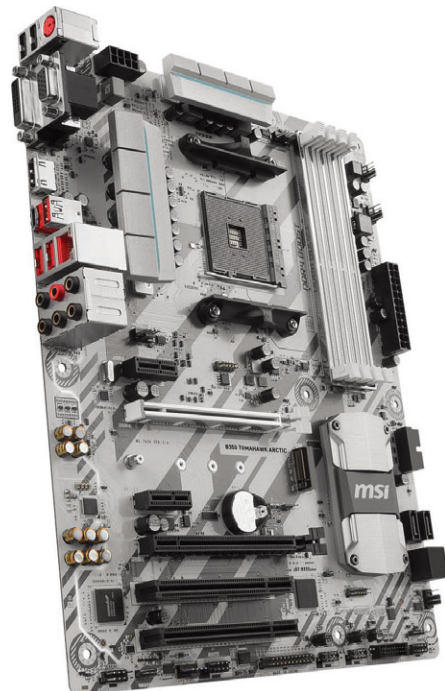
Why You'll Dig It: If you're tired of the same black mainboard, check MSI's ARCTIC options, which feature a blend of white, silver, and grey throughout the PCB and heatsinks. The B350 TOMAHAWK ARCTIC brings the winter look to AMD's Ryzen processors, and MSI fills the board with ways to keep your hardware icy cold. There are six fully controllable fan headers, so you can manage fan speeds, as well as switch between DC/PWM modes. Within the BIOS or MSI's Command Center, you can customize the fan speed curves and set up to four temperature targets for your CPU or motherboard. To ideally support liquid-cooling pumps and AIO coolers, the B350 TOMAHAWK ARCTIC features a dedicated water pump fan header that supports up to two amps. MSI even helps to keep your M.2 SSD from thermal throttling by including an M.2 heat shield.

Who Should Apply: AMD system builders who want a motherboard that stands out inside a case, while also delivering the hardware support necessary for a power user rig.

Socket: AMD AM4

Expansion slots: 1 PCIe 3.0 x16, 1 PCIe 2.0 x16, 2 PCIe 2.0 x1, 2 PCI

Maximum memory support: 64GB DDR4-3200



ASUS ROG STRIX X299-E GAMING

\$349.99

www.asus.com

Why You'll Dig It: This board can automate system tuning with your Core X-Series processor using ASUS' 5-Way Optimization technology. For fine-grain adjustments, ASUS also provides a dedicated base-clock generator designed for Core X-Series chips, and it works with TPU (TurboV Processor Unit) technology to enhance voltage and base-clock overlocks. There are two M.2 slots on the motherboard, and each features a heatsink to ensure consistent performance from your PCIe SSD. ASUS provides dedicated 3D mounts to fit 3D parts onto the motherboard, such as an M.2 fan holder. ASUS even provides a free downloadable design for the fan holder. You'll also find a host of onboard additions to support high-quality audio, networking, and storage. For example, the ROG Strix SupremeFX audio technology gives you full control over onboard sound.

Who Should Apply: System builders who want some help maximizing the speed and performance of their Core X-Series rig.

Socket: LGA 2066

Expansion slots: 3 PCIe 3.0 x16, 1 PCIe x4, 1 PCIe 3.0 x1

Maximum memory support: 128GB DDR4 4133 (Skylake-X) or 64GB DDR4-4133 (Kaby Lake-X)



EVGA Z270 Classified K

\$299.99

www.evga.com

Why You'll Dig It: EVGA engineers the Z270 Classified K for overclockers. Your CPU will enjoy plenty of clean power, thanks to a 13-phase digital VRM and a CPU socket powered by two 8-pin EPS headers. EVGA also includes some of its tried-and-true overclocking favorites. EZ Voltage read points and Probe It connectors, for instance, let you easily attach and hold multimeter leads, and the E-LEET tuning suite is a great tweaking tool. The Z270 Classified K also boasts some of the biggest VRM and PCH heatsinks we've seen, and EVGA runs a metal heat pipe between the giant heatsinks. EVGA says the heat pipes help to distribute heat among the onboard cooling. To simplify the overclocking process, there are onboard power, reset, and clear CMOS buttons, as well as a BIOS switch. Troubleshooting is easy, too, thanks to a series of onboard LEDs that indicate whether slots are active and operating correctly.

Who Should Apply: Overclockers looking to push a Skylake or Kaby Lake chip.

Socket: LGA 1151

Expansion slots: 3 PCIe 3.0 x16, 3 PCIe x1

Maximum memory support: 64GB DDR4-3600



Supermicro C9X299-PG

MSRP: To be announced
www.supero.com

Why You'll Dig It: Designed for use with a high-end workstation or extreme gaming PC, the C9X299-PG combines enthusiast features with Supermicro's Server DNA. For example, the motherboard features digital PWM controllers, Dr.MOS MOSFETs, and Ferrite chokes for stability when overclocking and processing demanding workloads. Impressively, the motherboard includes two M.2 and two U.2 ports to support multiple PCIe SSDs. The M.2 ports are fed by the chipset and support RAID 0 and 1 without Intel VROC. For high-speed I/O connectivity, there are four USB 3.1 ports (1 Type-C and 3 Type-A) on the rear panel. Supermicro includes two NICs, and one is a 5Gbps LAN port powered by an Aquantia AQC 108. The 5Gbps LAN port uses the same connector and Ethernet cable as standard Ethernet cable.

Who Should Apply: Enthusiasts in need of an extremely reliable X299 motherboard that can handle today's fastest hardware.

Socket: LGA 2066
Expansion slots: 4 PCIe 3.0 x16
Maximum memory support: 128GB DDR4-3733 (Skylake-X) or 64GB DDR4-3700 (Kaby Lake-X)

(Picture is engineering sample and subject to change)



AORUS GA-AX370-Gaming 5

\$194.99
www.aorus.com

Why You'll Dig It: With the AORUS GA-AX370-Gaming 5, GIGABYTE does an excellent job utilizing the assets of Ryzen processors and the X370 chipset. To help you get the most out of Ryzen processors—all of which are overclockable—AORUS uses a 6+4 phase power delivery design hosted by 4th generation IR (International Rectifier) digital power controllers with 3rd generation PowIRstage ICs. The GA-AX370-Gaming 5 also includes an M.2 port and a U.2 port (though both can't be active at the same time) to support a high-speed PCIe SSD. GIGABYTE ups the USB 3.1 count (from two to four) by installing an ASMedia USB 3.1 controller that provides the rear panel with one USB 3.1 Type-C port and one USB 3.1 Type-A port. RGB Fusion LEDs can be found throughout the motherboard, and there's also an RGBW LED strip extension header to let you sync up system lighting.

Who Should Apply: Enthusiasts building around the Ryzen platform who want to push performance limits.

Socket: AMD AM4
Expansion slots: 3 PCIe 3.0 x16, 3 PCIe x1
Maximum memory support: 64GB DDR4-3200



X299 AORUS Gaming 7

\$399.99

www.aorus.com

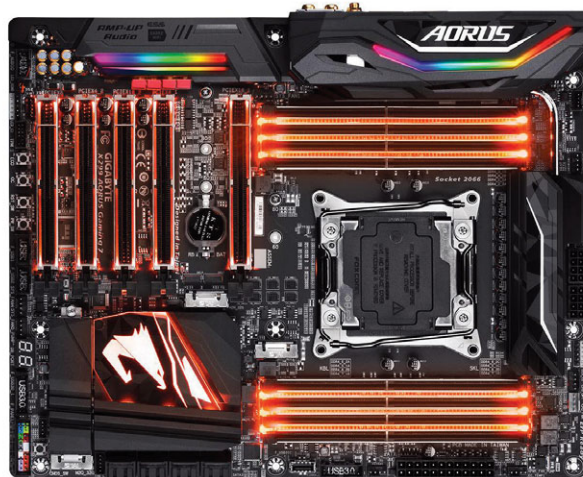
Why You'll Dig It: Intel's Core X-Series processors and the X299 chipset provide much of the device support power users need, so an X299 motherboard needs some unique amenities to stand out. On the X299 AORUS Gaming 7, GIGABYTE adds a Turbo B-Clock IC that allows linear BCLK adjustments (from 90MHz to 500MHz), and you can also adjust the CPU PEG bus, chipset PCIe bus, and DMI bus (from 100MHz to 200MHz). You'll get studio-grade sound, thanks to an ESS SABRE HiFi DAC that provides 32-bit, 384kHz audio processing. You can also customize onboard sound via Creative Sound BlasterX 720—an engine that uses algorithms to optimize the audio experience. For example, there's a Scout Radar feature that lets you use a smartphone to visualize the location of in-game enemies based on the game audio. To enhance the board's look, the X299 AORUS Gaming 7 features digital LEDs that allow for additional light patterns and effects.

Who Should Apply: Builders who want a feature-rich X299 motherboard to support their enthusiast tasks.

Socket: LGA 2066

Expansion slots: 5 PCIe 3.0 x16

Maximum memory support: 128GB DDR4-4400 (Skylake-X)
or 64GB DDR4-4400 (Kaby Lake-X)



MSI X299 GAMING PRO CARBON AC

\$349.99

us.msi.com

Why You'll Dig It: The X299 GAMING PRO CARBON AC is one of the best boards for modders. MSI includes swappable carbon, gold, and silver colored heatsink covers, as well as support for custom 3D printed parts via 3D X-MOUNTING screws. Mystic Light RGB LEDs throughout the motherboard let you customize the board's lighting, too. You can sync the LED lighting with a 5050 RGB LED strip via the board's 4-pin RGB LED header, and MSI includes an 80cm extender cable with a splitter to connect two more RGB strips. The motherboard's Intel wireless/Bluetooth adapter lets you remotely control LED lighting from your smartphone. For extreme performance, MSI gives the X299 GAMING PRO CARBON AC a 12-phase, digital power design that optimizes power delivery and current precision.

Who Should Apply: Enthusiasts who want a high-end X299 motherboard with flexible aesthetics for ultimate mod potential.

Socket: LGA 2066

Expansion slots: 4 PCIe 3.0 x16, 2 PCIe 3.0 x1

Memory support: 128GB DDR4-4133 (Skylake-X)
or 64GB DDR4-4500 (Kaby Lake-X)



MOTHERBOARD COMPARISON CHART
BUYER'S GUIDE

Motherboard	MSRP	Form Factor	Max Memory	Expansion Slots	Storage	Rear Panel USB Ports	Warranty
GIGABYTE X299 AORUS Gaming 7	\$399.99	ATX	128GB DDR4-4400 (Skylake-X) or 64GB DDR4-4400 (Kaby Lake-X)	5 PCIe 3.0 x16	3 M.2, 8 6Gbps SATA	5 USB 3.1, 4 USB 3.0	3 years
MSI X299 GAMING PRO CARBON AC	\$349.99	ATX	128GB DDR4-4133 (Skylake-X) or 64GB DDR4-4500 (Kaby Lake-X)	4 PCIe 3.0 x16, 2 PCIe 3.0 x1	2 M.2, 1 U.2, 8 6Gbps SATA	2 USB 3.1, 4 USB 3.0, 3 USB 2.0	3 years
ASUS ROG STRIX X299-E GAMING	\$349.99	ATX	128GB DDR4-4133 (Skylake-X) or 64GB DDR4-4133 (Kaby Lake-X)	3 PCIe 3.0 x16, 1 PCIe 3.0 x4, 1 PCIe 3.0 x1	2 M.2, 8 6Gbps SATA	2 USB 3.1, 4 USB 3.0, 2 USB 2.0	3 years
Supermicro C7Z270-PG	\$339	ATX	64GB DDR4-3733	4 PCIe 3.0 x16, 1 PCIe x4	2 M.2, 2 U.2, 6 6Gbps SATA	4 USB 3.1, 2 USB 3.0, 2 USB 2.0	3 years
EVGA Z270 Classified K	\$299.99	ATX	64GB DDR4-3600	3 PCIe 3.0 x16, 3 PCIe x1	3 M.2, 1 U.2, 8 6Gbps SATA, 2 SATA Express	2 USB 3.1, 4 USB 3.0	3 years
EVGA X299 Micro	\$269.99	microATX	64GB DDR4-3600 (Skylake-X) or 32GB DDR4-4100 (Kaby Lake-X)	3 PCIe 3.0 x16	1 M.2, 1 U.2, 6 6Gbps SATA	2 USB 3.1, 6 USB 3.0	3 years
ASUS ROG CROSSHAIR VI HERO	\$254.99	ATX	64GB DDR4-3200	2 PCIe 3.0 x16, 1 PCIe 2.0 x16, 3 PCIe 2.0 x1	2 M.2, 8 6Gbps SATA	2 USB 3.1, 8 USB 3.0, 4 USB 2.0	3 years
MSI Z270 GAMING M7	\$249.99	ATX	64GB DDR4-4133	3 PCIe 3.0 x16, 3 PCIe 3.0 x1	3 M.2, 1 U.2, 6 6Gbps SATA	2 USB 3.1, 2 USB 3.0, 3 USB 2.0	3 years
GIGABYTE AORUS GA-Z270X-Gaming 7	\$229.99	ATX	64GB DDR4-4133	3 PCIe 3.0 x16, 3 PCIe x1	2 M.2, 1 U.2, 6 6Gbps SATA, 3 SATA Express	2 USB 3.1, 5 USB 3.0	3 years
ASRock X370 Taichi	\$209.99	ATX	64GB DDR4-3200	2 PCIe 3.0 x16, 1 PCIe 2.0 x16, 2 PCIe 2.0 x1	2 M.2, 10 6Gbps SATA	2 USB 3.1, 6 USB 3.0	3 years
GIGABYTE AORUS GA-AX370-Gaming 5	\$194.99	ATX	64GB DDR4-3200	3 PCIe 3.0 x16, 3 PCIe x1	1 M.2, 1 U.2, 8 6Gbps SATA, 2 SATA Express	4 USB 3.1, 6 USB 3.0	3 years
ASRock Z270 Extreme4	\$164.99	ATX	64GB DDR4-3866	3 PCIe 3.0 x16, 3 PCIe 3.0 x1	2 M.2, 8 6Gbps SATA	2 USB 3.1, 4 USB 3.0	3 years
MSI B350 TOMAHAWK ARCTIC	\$119.99	ATX	64GB DDR4-3200	1 PCIe 3.0 x16, 1 PCIe 2.0 x16, 2 PCIe 2.0 x1, 2 PCI	1 M.2, 4 6Gbps SATA	4 USB 3.0, 2 USB 2.0	3 years
Supermicro C9X299-PG	TBA	ATX	128GB DDR4-3733 (Skylake-X) or 64GB DDR4-3700 (Kaby Lake-X)	4 PCIe 3.0 x16	2 M.2, 2 U.2, 6 6Gbps SATA	4 USB 3.1, 2 USB 3.0, 2 USB 2.0	3 years

SUPER PREMIUM GAMING KEYBOARD

CHOOSE YOUR BEST BUDDY



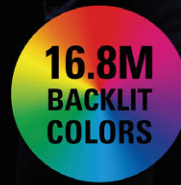
Topre Capacitive Key Switch

Superior key touch feel.
No chattering.
No contact mechanism.
Made in Japan.



Actuation Point Changer (1.5 / 2.2 / 3mm)

Customize various points for detecting key activations, making it 25% faster than competing mechanical keyboards. Switch to lightning fast responsiveness for gaming or adjust it for accuracy in typing.



RGB Per-Key Backlighting

Customize your keyboard's backlighting through the included software application with a spectrum of over 16.8 million colors.



Software

Program your actuation points and backlit colors with ease.
The software is available to download from www.realforce.co.jp.

REALFORCE RGB

Scrap The Bloatware From Windows 10

It would not be an understatement to say we're fans of Windows 10. From a performance and UI standpoint, this latest Microsoft OS is one of the best yet. But if things were perfect, then we wouldn't focus on Win10 quite so much in the pages of Software Tips & Projects. One of the most glaring flaws of the OS is the slew of unwanted apps that install themselves by default. Examples of these include the Get Office, Tips, Get Skype, Money, News, Get Started, Feedback Hub, Microsoft Solitaire Collection, One Note, and Health & Fitness apps. Sometimes you can remove them manually, but following major OS updates, such as the Anniversary Update or the Creator's Update, or sometimes for no discernable reason whatsoever, these apps rise from the dead to once again consume your valuable storage space, plague your Action Center with annoying popup notifications, and make you question whether the trusty Add Or Remove Programs utility even functions properly.

Laptops and smartphones are no strangers to bloatware, but those apps are generally from third-party developers and organizations that supposedly pay fees designed to nibble away at manufacturing costs, which in theory should reduce the price you pay for these high-tech devices. Win10 isn't any cheaper than previous versions of the OS, and for builders installing an OEM or retail copy of the OS for an existing PC or a system they've built, there's nothing to justify the subsidy proposition. Even Windows 10 Enterprise suffers from the onslaught of preinstalled trash. It's advertising, pure and simple, and getting rid of it once and for all isn't as straightforward as you would think. Thankfully, there's a way to do it, at least semi-permanently, and we'll show you how.



The Windows PowerShell logo is merely a prompt, but the utility itself is actually an incredibly useful tool for power users.

The Easiest Method First

Although performing the (mostly) permanent removal process isn't difficult, it's best to start with the easiest solution first. This involves finding the app in the all apps list by clicking the Start button, right-clicking the icon of the offending app, and then clicking Uninstall. Performing this commonly works for a number of the unwanted utilities such as Get Office, Reading List App, Sports, Money, News, Get Started, and others.

You can also click into the search box and type **add or remove programs** and then press ENTER to launch the standard Windows app uninstalling utility. Then just scroll to and click the application you want to uninstall and then click the Uninstall button.

Get Rid Of The Zombies

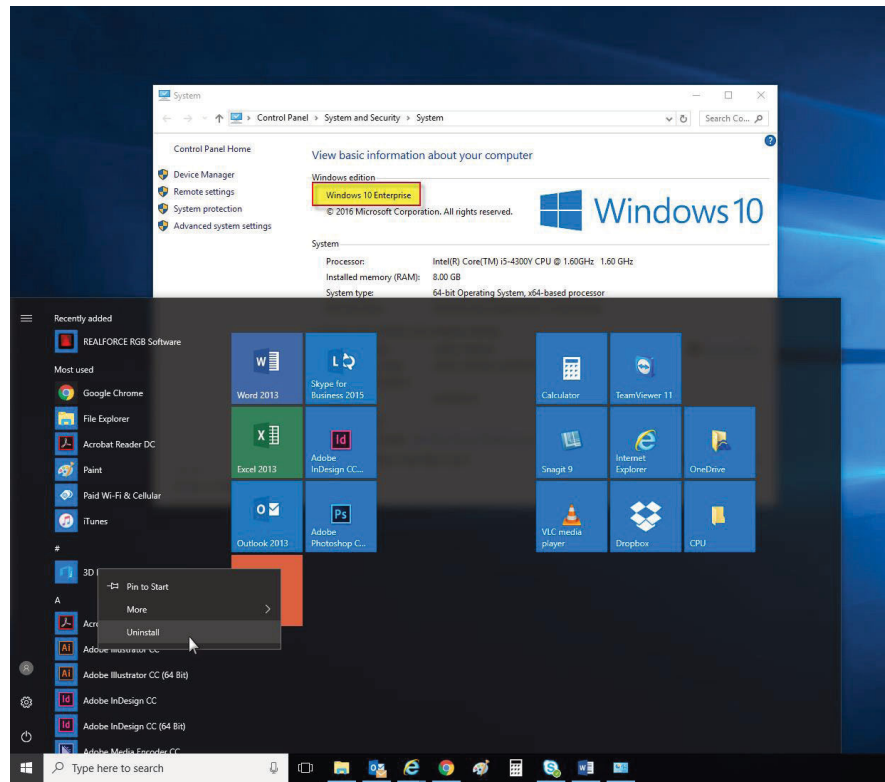
On the utilities that Microsoft appears to consider core to the Win10 experience, the apps will often have a listing in the Add Or Remove Programs utility, but the Uninstall button will be greyed out, preventing you from easily removing it. But we assure you, these apps are mortal. Some of the apps that fall into this category include Weather, People, Xbox, OneNote, Store, and Sticky Notes, among others. To expunge these EXEs, you'll need to access the Windows PowerShell and use the "Get-AppxPackage" and "Remove-AppxPackage" cmdlets (pronounced "command-let"). According to Microsoft, cmdlets are single-feature commands that manipulate objects in Windows PowerShell.

We haven't spent much time covering the ins and outs of PowerShell, but if this is your first time using the command line-based utility, make sure you exercise extreme caution. PowerShell can make some pretty low-level configuration changes to how your system functions, and you won't get any gentle reminders that you might want to think twice before you execute a string.

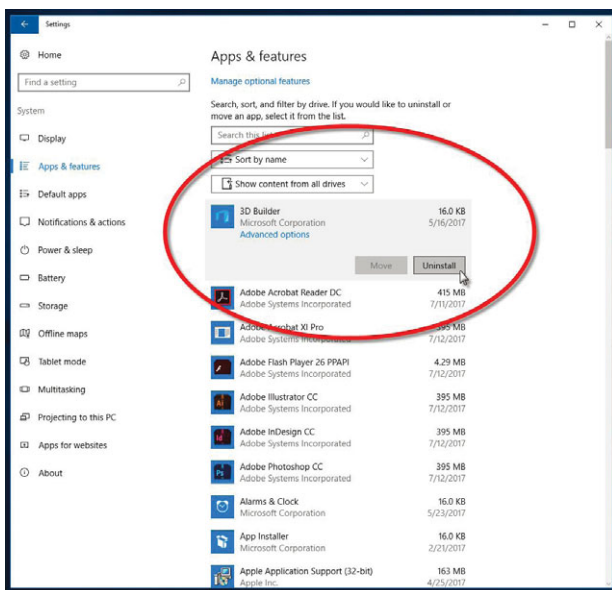
PowerShell Tutorial

One of the easiest ways to access the PowerShell for first timers is to simply click in the Windows Search box and type **powershell**, then right-click the top result and click Run As Administrator. Click Yes when the UAC prompt appears to dismiss it. PowerShell's UI looks a lot like the Command Prompt, complete with the directory location residing to the left of the blinking prompt.

To get started, let's delete the 3D Builder utility, even though it's easily removable from the Add Or Remove Programs utility. At the PowerShell prompt type **get-appxpackage *3dbuilder* | remove-appxpackage** and then press ENTER to execute the command. This command doesn't appear to be case-sensitive, so if you're



Windows 10 comes preloaded with a bunch of apps that are of questionable value to most end users.



The traditional method of uninstalling apps works... Most of the time.

accustomed to initial capping words in a string, you can do this, for instance by alternately typing **Get-AppxPackage *3DBuilder* | Remove-AppxPackage**. What is important about the syntax of the PowerShell commands you input, however, are the symbols, spaces, and of course, spelling.

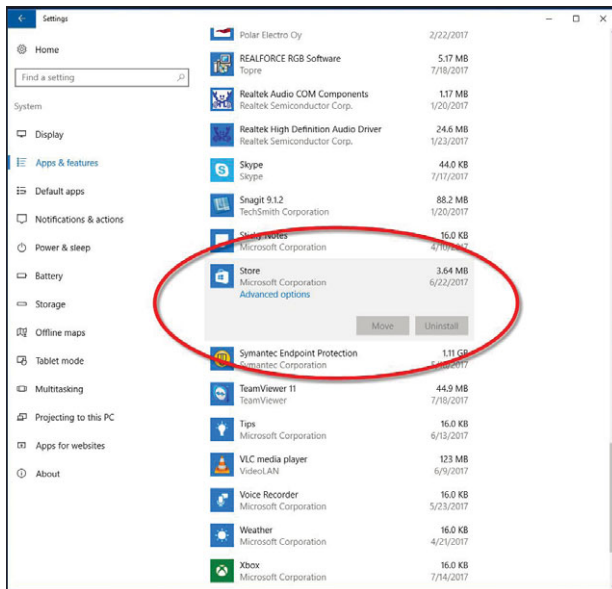
In the event that you add an unnecessary space, or omit a hyphen, you'll likely get an error message to the effect of, "term not recognized as the name of a cmdlet, function, script file, or check the spelling of the name, or if a path was included, verify that the path is

correct and try again." This message will be followed by the string you input, with the error-inducing section highlighted in red.

Syntax Matters

You can use the PowerShell to effectively remove any application that's not considered imperative, all you really need to know is the correct syntax of the name of the utility, or AUMID (Application User Model ID). Unfortunately, these AUMIDs aren't always intuitive. For most of them, the utility's PowerShell-recognizable name is all lower-case, with any spaces removed. For instance, uninstalling the Get Started app is easy to do, all you need to do is input "getstarted" between the asterisks of the previously mentioned command in PowerShell.

Other less intuitive AUMIDs include Camera, Maps, and Calculator, which are actually recognized as "windowscamera," "windowmaps,"



Some apps you might want to remove require the Windows PowerShell and a very specific cmdlet.

and “windowscalculator.” Other apps have even less obvious AUMIDs, such as Money, Get Skype, Get Office, and Phone Companion, which are referred to as “bingfinance,” “skypeapp,” “officehub,” and “windowsphone,” respectively. To get a tiny inkling of how Microsoft’s software is so often built on top of older ideas, consider that the AUMID for Groove Music is “zunemusic.”

If you input the wrong AUMID in between the asterisks in PowerShell and press ENTER, nothing will happen other than a new blank prompt will appear. This is the same thing that happens if you try to remove a program or utility that doesn’t exist on your system, which means you can run the whole series of commands we list in this article without checking to see if the app is something you have installed. Just make sure you actually don’t use the app before removing it. (Though, later, we’ll show you how to invite all of these banished apps back in one fell swoop.) The uninstall commands for a variety of built-in apps are listed below, however, we do consider many of them to be rather useful, and you should use this list as a series of optional PowerShell commands.

Locating Your Windows Store AUMIDs

A little later in this article, we list the PowerShell commands that you can use to expunge numerous apps from your system, but it is by no means an exhaustive list. If we failed to list the uninstall command you’re looking for, you can use PowerShell to display a list of every Windows Store app installed on your system . . . using a rather verbose command. Type this exactly as it appears here to display them all:

```
$installedapps = get-AppxPackage

$aumidList = @()
foreach ($app in $installedapps)
{
    foreach ($sid in (Get-AppxPackageManifest $app).package.applications.application.id)
    {
        $aumidList += $app.packagefamilyname + "!" + $sid
    }
}

$aumidList
```

The actual AUMIDs appear following the “Microsoft.” and after the underscore and alphanumeric string of characters. Using this method, we discovered dozens of Windows Store apps, however, not all of them are removable. We’ll take a look at the apps you won’t be able to excise using PowerShell a bit later.

Uninstall Commands

For those of you reading this article on the web, you can simply copy and paste

these commands right into PowerShell and run them. For those reading the print edition, you can type the string out once to uninstall an app of your choice, then press UP ARROW key in PowerShell to display the last string you input, then use the LEFT ARROW key to back up to the app’s name between the asterisks to just change that portion. As a side note, if you’re accustomed to using shortcuts in Command Prompt, many of them will also work in PowerShell. Without further ado, here are the uninstall commands for a whole bunch of Win10 apps that have varying degrees of usefulness.

To uninstall the Camera app, which is utterly wasted on a desktop PC that lacks a webcam, use this command: `get-appxpackage *windowscamera* | remove-appxpackage`

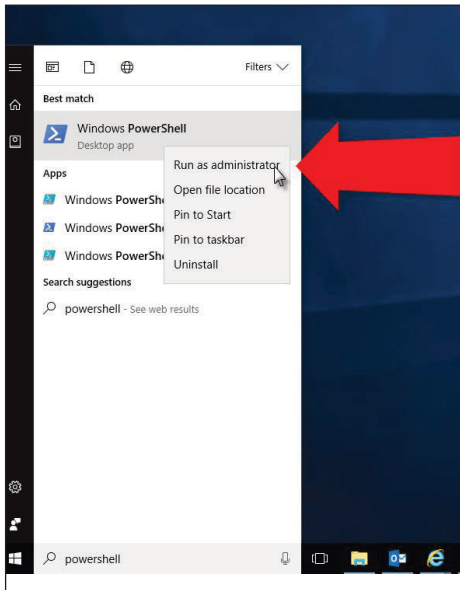
The obnoxious Get Office app is effectively an advertisement for Microsoft Office, so it’s one of the first things we typically get rid of after installing Win10. To show Get Office to door, use this PowerShell command: `get-appxpackage *officehub* | remove-appxpackage`

Get Skype is another advertisement for an app that some people love and others don’t. Input this command to un-get it: `get-appxpackage *skypeapp* | remove-appxpackage`

If you’re new to Win10, you might like the Get Started app, but for most of us, it’s completely unnecessary. Show this hand-holding tutor to the door with the following command: `get-appxpackage *getstarted* | remove-appxpackage`

The Maps app is vital if you’re using Win10 on a mobile device like a tablet or laptop, but for desktop users, it’s mostly useless, offering little tangible benefits compared to a web-based mapping utility. Crumple Maps with this command: `get-appxpackage *windowsmaps* | remove-appxpackage`

It’s safe to say that Solitaire was one of Windows’ first, and perhaps most enduring, killer apps, but many users aren’t as keen on the reimagined version called the Microsoft Solitaire Collection. Use this command to say sayonara to Solitaire: `get-appxpackage`



Make sure to right-click the icon for PowerShell and select Run As Administrator.

***solitairecollection* | remove-appxpackage**

The Money app isn't terrible per se, it's just little better than any of a variety of financial websites you could bookmark and visit instead. Remove it with this: **get-appxpackage *bingfinance* | remove-appxpackage**

OneNote, Microsoft's note-taking and collaboration utility is a Win10 preinstall, but there are a variety of alternatives available that are better or at least just as good. To issue OneNote its pink slip, use this command: **get-appxpackage *onenote* | remove-appxpackage**

Microsoft has had mixed results when it comes to the firm's social media efforts, and for many, the People app is a misstep. To issue the People app its marching orders, use the following PowerShell command: **get-appxpackage *people* | remove-appxpackage**

Microsoft's Phone Companion app is one of those things that some people love, and others just have no use for it. You can unfriend this app by inputting the following command: **get-appxpackage *windowsphone* | remove-appxpackage**

This app is generally more useful for a mobile device, but less so for

a desktop PC. Permanently hit the snooze button on Alarms and Clock with this PowerShell command: **get-appxpackage *windowsalarms* | remove-appxpackage**

Perhaps our favorite Windows app is the Calculator, if only because every time we use it, we remember our high school algebra teacher swearing that we won't always have a calculator handy. She's probably the only one who would think of uninstalling the Calculator, but here it is anyway: **get-appxpackage *windowscalculator* | remove-appxpackage**

There are a lot of competent alternatives for managing calendar events and email, so if the Calendar and Mail apps are just taking up valuable space, use this command to reclaim it: **get-appxpackage *windowscommunicationsapps* | remove-appxpackage**

OK, it's no Winamp, but Groove Music is one of the handful of Win10 apps that does a serviceable job of letting you manage your music, subscribe to an unlimited music service, and buy or listen to snippets of new music. If you'd rather use anything else, use this command:

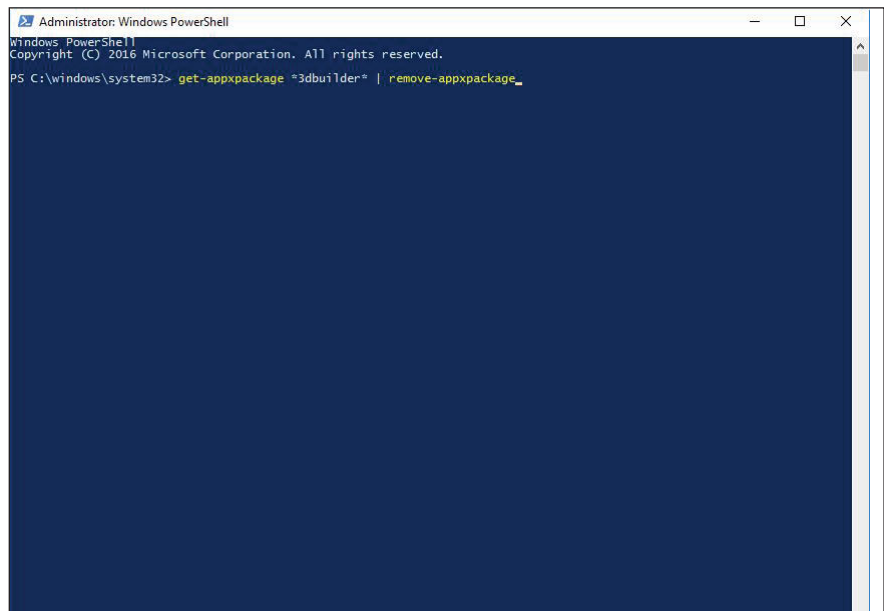
get-appxpackage *zunemusic* | remove-appxpackage

For us, the Movies & TV app is just as sufficient as the music app, and we like the similar look and feel between the two UIs. If you're less inclined to agree, and want to remove this one as well, use this command: **get-appxpackage *zunevideo* | remove-appxpackage**

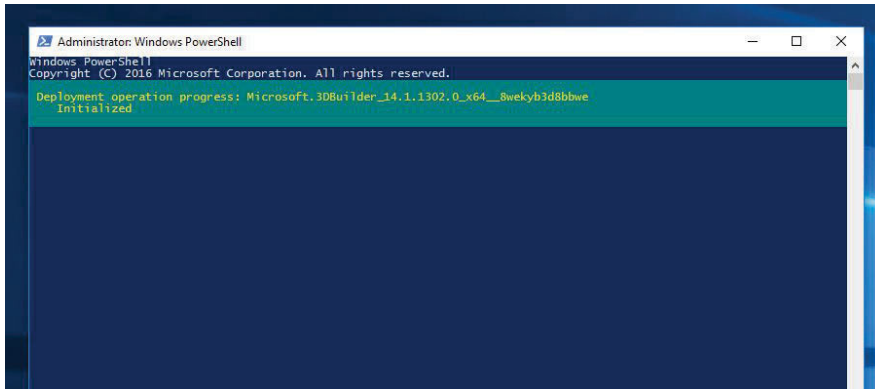
With the proliferation of Fake News threatening to upend your world view on a daily basis, it's important to only read news from sources you trust. We're not saying that news gathered by a Microsoft-controlled algorithm is *always* untrustworthy, but making sure you're never led astray is as easy as running this simple command: **get-appxpackage *bingnews* | remove-appxpackage**

For an app that lets you quickly look at photos, with some very basic editing functions thrown in for cropping, rotating, and color adjusting, the Photos app does a decent job. If you prefer to use one of the dozens of available alternatives, feel free to input the following command: **get-appxpackage *photos* | remove-appxpackage**

If you'd like to create the opposite of Windows 10 S, the version of the OS



The "get" and "remove" cmdlets are what we'll be using for this series of hard-to-remove apps.



When you successfully remove an app using a PowerShell cmdlet, a message like this will appear for a fraction of a second.

that only lets you install apps from the Windows Store, you can do so by running this command, which strips the Store from your system: `get-appxpackage *windowsstore* | remove-appxpackage`

We are big fans of sports, where the guys do that thing with the balls and score all those points. Seriously, huge fans. But if you're not a huge fan of the Bing-aggregated sports news, run this command: `get-appxpackage *bing sports* | remove-appxpackage`

The Voice Recorder app is one we rarely have occasion to use. If you feel the same, run the following command to silence it: `get-appxpackage *soundrecorder* | remove-appxpackage`

Win10's live tiles are really hit or miss with users. We generally like being able to see a concise five-day forecast when we hit the Start button. If you don't ever use the weather app, run this command to rain on its parade: `get-appxpackage *bingweather* | remove-appxpackage`

We try to not get too PCMasterRace in these pages because we know that games are more important than the platform, and the gamer who rejects any gaming platform will end up missing out on some amazing experiences. If you're not interested in Microsoft's piece of the gaming sphere, then you'll probably want to remove the Xbox app using this command: `get-appxpackage *xboxapp* | remove-appxpackage`

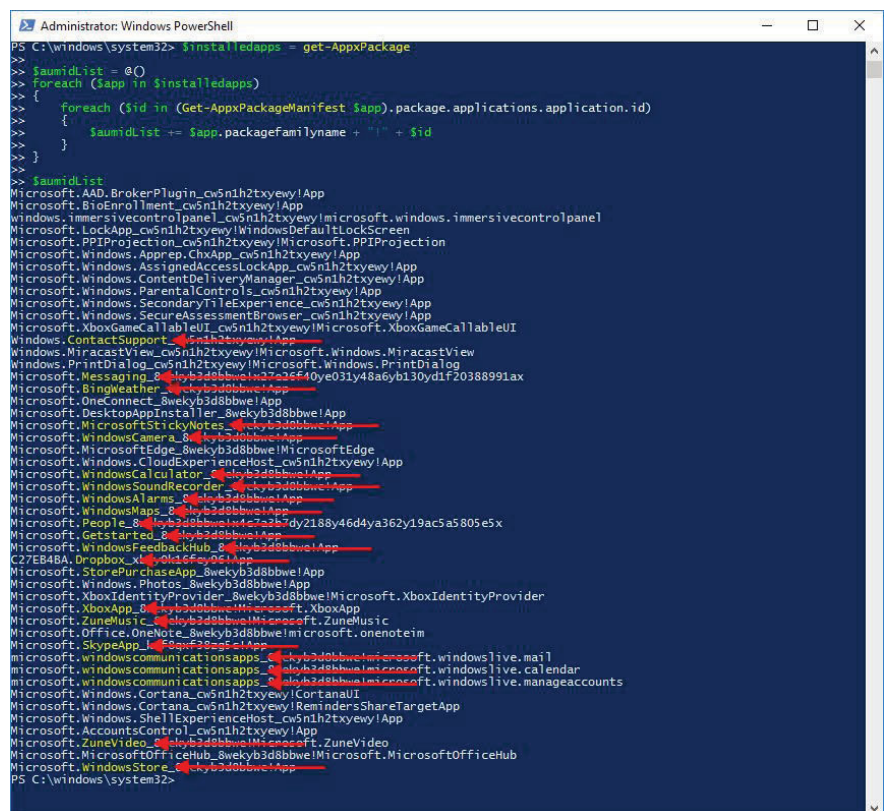
The Forbidden Apps

If you've found yourself trying to get rid of an app, and simply can't using the Add Or Remove Programs utility or a PowerShell cmdlet, then chances are good you're trying to toss one of the handful of

apps that are off limits. Basically, you're stuck with them whether you use them or not. Microsoft Edge, Cortana, Contact Support, and Windows Feedback are just a few examples of apps that are off-limits.

It's In Your Hands

The ability to take control of virtually every aspect of the software is one of the reasons we love Windows. Microsoft's latest OS really does let you tap into a remarkable number of the UI features and OS mechanics. And even though we just got done mentioning a few of the things you can't do via the incredibly powerful PowerShell, we're pretty sure someone somewhere has figured out a workaround to accomplish these seemingly forbidden tasks. That's the other reason we love Windows: there's a massive army of empowered users tirelessly working to find ways to improve the platform every day. ■



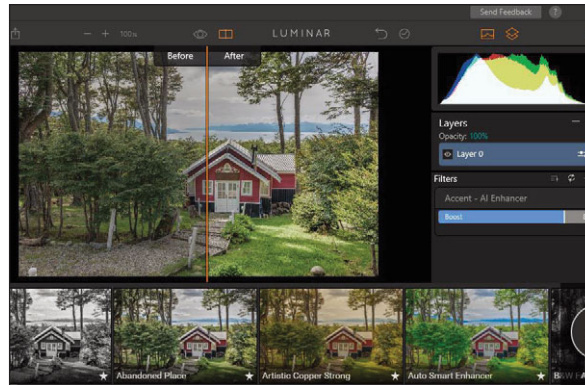
Looking up your Windows Store AUMIDs lets you determine the exact syntax of any Windows Store app installed on your system.

Inside The World Of Betas

MACPHUN SOFTWARE LUMINAR FOR WINDOWS BETA

True or not, lots of folks believe the following two things: With the right camera and the right software anyone can now produce professional-grade photography, and Macs are the best computers for such software. For years, Macphun Software's Luminar has at least been solid evidence for Mac partisans who insist their platform is the best for image editing. This July, Macphun decided to let Windows users in on the, ahem, fun, releasing the Luminar for Windows public beta.

Boasting over 300 tools and features, Luminar is a non-destructive image editor with a lot of the capabilities of bigger and more expensive programs (hint: rhymes with "Proto Hop"). RAW support, layers, masking, plug-ins—Luminar can do it. These are all potent weapons in a photographer's arsenal, but Luminar is even more than that. Luminar is fun.



Go ahead and jump in on the Luminar public beta (you'll need to supply Macphun with an email address in order to obtain an activation code), play with the program's AI-fueled photo filter, and tell us you aren't having a good time. Of course, once you've finished taking Luminar's automagical filter for a spin, you'll find that it's also jam-packed with a

host of other traditional filters. In short, you're often a mere click or two away from creating breathtaking images in Luminar.

Luminar is serious software, giving you workspaces, a history panel, and broad image format support. (Yes, that includes .PSD.) By the end of the year, batch processing should also be supported, just in time for the Windows version's stable release. ■

Luminar For Windows Beta

Publisher and URL: Macphun Software; <https://macphun.com>

ETA: Q4 2017

Why You Should Care: One of the most popular and powerful image-editing tools for Macs is coming to PC.

TWEAKPOWER 0.020 BETA

Every once in a while we come across intriguing new software that seems tailor-made for the enthusiast crowd. Exhibit A is Kurt Zimmermann's TweakPower. It lets you tweak your system, with power! What more could a *power* user want?

Joking aside, we have no shortage of utilities designed to keep our machines in tip-top shape. Whether free (Piriform CCleaner, Ashampoo WinOptimizer) or commercial (iolo System Mechanic, Symantec Norton Utilities), choices abound. Developer Kurt Zimmermann is wading into crowded waters, but power users typically stand to benefit from a little friendly competition.

Like any good tune-up program, TweakPower presents a menu that's flush with options, even if it initially appears a little sparse. For example, by default the Optimize tab has a single clickable action:



Optimize Now. (TweakPower does reveal some of optimizations this includes, such as faster shutdowns, shorter crash delays, and storage drive acceleration.) However, if you click the nearly blink-and-you'll-miss-it settings icon, you'll expose all the individual changes that the Cleaning tab covers; you can then pick what you want. Similarly, all of TweakPower's cleaners—Registry, Browser, System, and

Plug-in—have the same settings icons that gives you much more control over how the program does its job.

Could TweakPower's UI make the ability to drill down to these individual optimizations more obvious (and be a bit cleaner in general)? Sure, but in light of everything the app can do, it's a minor quibble. As it stands, Zimmermann's program puts a lot of tweaks at your fingertips and doesn't cost a dime. ■

TweakPower 0.020 Beta

Publisher and URL:

Kurt Zimmermann; <https://kurtzimmermann.com>

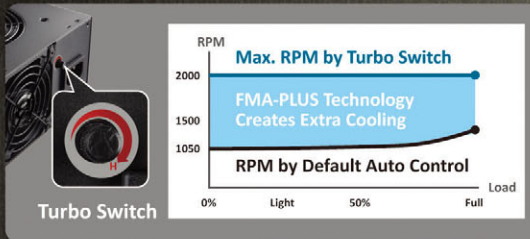
ETA: TBD

Why You Should Care: You want tweaks? TweakPower has 'em in spades.



Exceed GOLD

Turbo Switch with FMA-PLUS Technology to Unleash 100% Cooling Capacity of the Fans



700W/600W/500W

DUOFlow™ Design + FMA Technology
REVOLUTION DUO
Innovative Dual-fan Power Supply

Professional Tested
Reviewer Recommended



650W/550W

REVOLUTION SFX
Highest Wattage SFX Power Supply in 100mm Depth



Upgrades That'll Keep You Humming Along

You know the old saw “safety first.” It’s an important maxim for a lot of software developers, too. SpyShelter Premium keeps your PC safe, and IP Camera Viewer helps keep your residence safe. This month, we’re also featuring tools to help coders, bloggers, and researchers.

SOFTWARE UPDATES

CPUID CPU-Z 1.80

A staple among enthusiasts that has been around for ages, CPU-Z really needs no introduction, so we’ll jump straight to the details. Support for Intel’s new Core X CPUs (Kaby Lake-X and Skylake-X) is here, so if you’ve scooped up one of Chipzilla’s newest, uh, chips, go ahead and update CPU-Z, as well. On AMD’s side, version 1.80 also addresses Bristol Ridge.

www.cpuid.com

Perfect Surveillance IP Camera Viewer 3.8

Perfect Surveillance’s IP Camera Viewer should satisfy most home users searching for a free and easy way to keep tabs on multiple (up to 64 simultaneously) IP cameras. With support for over 1,200 cameras, it’s hard to imagine your model isn’t supported. (And even if it isn’t, you’re not out anything for trying.) Version 3.8 further expands the program’s list of supported IP cams, although Perfect Surveillance’s release notes don’t specify a precise number, adds a media player, and squashes some bugs. A June update gave IP Camera Viewer the ability to alert users via SMS.

www.perfect-surveillance.com

RJ TextEd 12.20

This freeware text and source editor from Rickard Johansson (as in “RJ”—get it?) wears a number of other hats. It doubles as a web development editor (PHP, ASP, JS, HTML, CSS), triples as a dual-pane file commander, and quadruples as an SFTP client. You won’t find

groundbreaking new features in version 12.20, but you will find a whole bunch of tweaks and optimizations, particularly to the program’s hex view. For example, the Quick Find bar now has a hex value button that lets you enter a search string of hexadecimals in hex view, and the search bar and modal search window now offer the ability to find/find all/replace/replace all in hex view.

www.rj-texted.se

SpyShelter Premium 10.9.3

Billed as the “world’s best anti-keylogger,” SpyShelter is a lightweight, rules-based program that protects against conventional keyloggers and a bunch of other nasties (screen loggers, sound loggers, webcam malware) that try to capture your activity. In the latest update, developers have bolstered the SpyShelter’s protection, correcting a security issue with the keystroke encryption driver and improving the app’s sound and webcam logging defenses. Users now also have the option import and export their keystroke encryption rules.

<https://www.spyshelter.com>

TumblrThree 1.0.6.13

If you’re addicted to Tumblr—whether that’s your own microblog, others’, or both—we’d guess that TumblrThree will come in very handy. The successor to TumblrTwo (surprise), TumblrThree is a FOSS backup utility for Tumblr blogs. It’s a great way to keep a copy of your Tumblr and preserve other Tumblrs in the event they vanish into the ether. A flurry of mid-July updates has whipped TumblrThree into shape, as it should now consume far fewer CPU and memory

resources, and it introduces a new feature that lets users download private blogs (those that require a login to view). The latest update also improves .RAW handling and resolves an issue that caused the downloader to randomly stall.

<https://github.com/johanneszab/TumblrThree>

Zotero 5.0.4

Evernote is great for grabbing content and information from seemingly everywhere, but Zotero is designed from the ground up to aid professional researchers. Although version 5.0.4 is the latest version, it, along with versions 5.0.1, 5.0.2, and 5.0.3, are merely maintenance updates; version 5.0 is the big one, and major additions are afoot. My Publications lets you compile a list of your output (articles, papers, books, and so forth) and share them on your Zotero profile page. Zotero also makes it easy to subscribe to academic journals’ feeds (RSS or Atom). The UI should be more responsive, and there are a lot of changes to Zotero’s note editor.

<https://www.zotero.org>

DRIVER BAY

Logitech Gaming Software 8.94.108

The tool that makes Logitech’s gaming gear go gets an update, which adds support for the following Logitech peripherals: G433 gaming headset, G903 and G703 LIGHTSPEED wireless gaming mice, and POWERPLAY wireless charging system. New game profiles for Prey and PLAYERUNKNOWN’S BATTLEGROUNDS are included, as well.

support.logitech.com

Match Makers

What Today's Gaming Groups Use To Win At Organization

Over the last few years, videogames have become a lot more exciting. Sure, to a certain extent that's self-evident; videogames have always been exciting. We wouldn't log hour after hour behind a keyboard or controller if it weren't for those strategically administered doses of dopamine for each achievement completed, trophy earned, or victory secured.

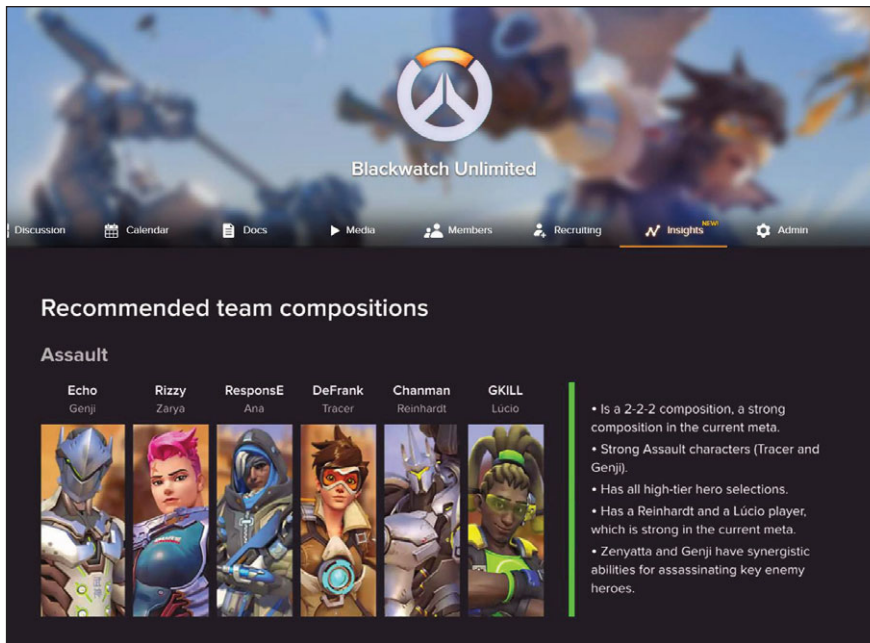
Gaming moved out of its parents' basement years ago, but it's now obvious to even those who don't regularly tune in to Counter-Strike: Global Offensive

matches on Twitch that eSports is capable of producing the same level of entertainment we've come to expect from traditional sporting competitions. We're not yet to the point where League of Legends is competing with the NFL for eyeballs and ad dollars, for example, but the momentum propelling professional events, tournaments, and teams is now impossible to ignore . . . or stop. Already a half-billion-dollar industry and poised to generate close to \$1.5 billion in revenue by 2020, competitive gaming as a profitable endeavor is only getting started.

Another sea change driving competitive gaming is its evolution into a bona fide spectator sport. To be sure, there are plenty of people who follow a particular game, and the professional teams that battle each other, because they enjoy playing that game themselves, but the most popular games are now drawing in viewers who just came to watch, so to speak. According to a report from market research firm NewZoo, 42% of people watching the top three eSports (LoL, DOTA 2, and CS:GO) don't actually play the game itself. Whether these games'



Although eSports fanatics can regularly identify the top teams that frequently make the main stage at professional gaming's most prestigious tournaments, plenty of work happens behind the scenes to keep the best of the best in fighting form. The good news for gamers at all levels is that many of the tools pros rely on for success are accessible to everyone. (Photo credit: Flickr user artubi)



Guided, currently in beta, is attempting to modernize the way teams, guilds, and other gaming groups organize and recruit talent. Currently, the service is available for a wide range of games, including League of Legends, Overwatch, DOTA 2, Counter-Strike: Global Offensive, World of Warcraft, and more.

audiences are participants themselves or among the millions of spectators watching on Twitch, their appeal as genuine sporting events is undeniable.

And like traditional pro sports, eSports have developed a high degree of visibility. DOTA 2's The International, for example, has been held at Seattle's Key Arena every year since 2012. The best teams and players maintain devoted fanbases who follow them with the same dedication as Bay Area basketball aficionados give Stephen Curry or Bostonians heap upon New England Patriots starting quarterback Tom Brady. When LoL megastar Lee Sang-hyeok, more commonly known as Faker, took to Twitch in early 2017, SK Telecom T1's renowned mid-laner pulled in more than 245,000 viewers. Such an audience made Faker's stream the most-watched of any individual streamer to use the platform and easily surpassed the live viewerships of other games. Faker's fame is arguably the best recent example of a recognizable eSports celebrity, especially in his home country South Korea, but there are plenty

of franchise faces throughout LoL and other popular videogames.

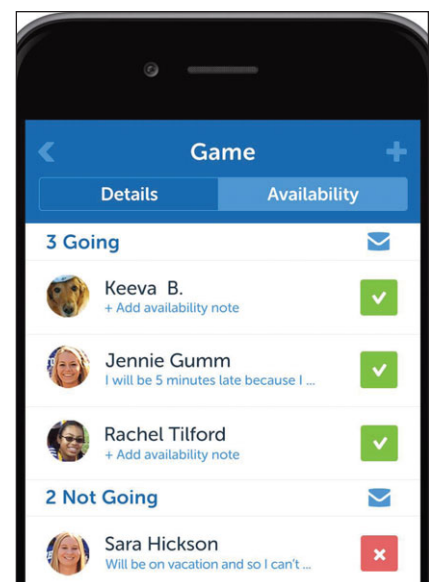
Although we have no shortage of colossal, sold-out venues, fantastically large prize pools (this year's International topped \$20 million in total prize money, with over \$9.1 million split between world champion Wings Gaming) or well-known eSports personalities, top teams consist of far more than what you see on the group stage. Indeed, continuing the traditional pro sports team analogy is appropriate, because an entire support infrastructure underpins the best and most competitive squads in eSports. Small, fledgling teams on the fringes of the pro scene may rely on a single "manager" who sees to his players' offline needs, but established franchises regularly employ entire teams to keep their eAthletes in fighting form and focused on the next match. Coaches, chefs, physical therapists, sports psychologists, webmasters, sales managers—plenty of work goes into winning championships beyond precise headshots and clutch counter ganks. For example, at the end of 2016 Team Liquid sought to hire a

chef and sports psychologist for its teams. In 2017, Liquid was seeking a full-time translator, as well as a handful of other non-gaming positions, for its LoL squad. They're not alone.

As we went to press, Blizzard announced a series of rules regarding player compensation that Overwatch League franchise owners must abide by. Every league player must receive a guaranteed one-year contract with an option to extend that contract for another year. The minimum annual salary for players is \$50,000, and teams must also provide their players with health insurance, retirement savings plans, and performance-based bonuses.

"Today, eSports teams have a better understanding of their own business models," says Michael Daudign, marketing director at Toornament (<https://www.toornament.com>). "They know how to get money and how to invest this money."

As professional eSports teams and other serious clans and guilds battle each other for the spoils of victory, whether that's glory, cold hard cash, or both, the stakes continue climbing



TeamSnap realizes the similarities between traditional sports and eSports team organization, which is why the company targets both with its service.

higher. Recognizing teams' desire to defeat their rivals, a number of companies are developing tools to help teams, tournament planners, and event organizers better coordinate their activities, analyze performance, and more.

Beyond The Friends List

By default multiplayer games let players connect with each other and form groups to accomplish shared objectives, whether that's bringing down the opposing team's Ancient or slaying a raid boss. Social media integration also gives players another way to maintain contact.

However, merely joining forces with friends and like-minded gamers isn't the same as coordinating a dedicated team or guild over the long haul. Managers must keep their teams together and focused on regular practice sessions and tournaments, not to mention attract new talent to supplement their roster(s).

"The challenge teams face is that most communication tools are only really good for one form of communication," says Guilded (<https://www.guilded.gg>) founder and CEO Eli Brown. "Discord or Skype are great for real-time communication, but not so great for scheduling events or recruiting. Forums are great for sharing strategies and builds, but not so great for real-time communication. It's challenging to manage all of these different forms of communication."

Guilded, which is now in beta on iOS and Android (Windows and Mac OS X versions are in alpha), aims to be teams' one-stop shop for communication and coordination. The service covers a wide range of games (all of the major titles and many others). It hooks into Discord for communication and uses Discord bots for a variety of tasks. With Discord integration, calendar announcements, video, applications, etc. can be automatically pushed to relevant team members.

Elsewhere, Guilded aims to be as lightweight as possible, getting teams and guilds off the ground in seconds, and presents groups with a streamlined calendar for scheduling practice sessions, raids, tournaments, and other team activities. Guilded's Members tab

A League Of Their Own: Q&A With Zack Johnson, Founder Of ggLeap & ggCircuit On Amateur eSports

Zack Johnson got his start in LAN gaming the way a lot of us did—small groups of gamers gathering in small venues. Johnson's journey began 13 years ago, when he hosted LAN parties in his local church before later setting up Xbox consoles and PCs in the spare space in some of his businesses. Today, Johnson's turned his passion for competitive gaming at the local level into ggLeap, a platform for gaming centers and retail outlets around the globe. Johnson spoke with us about the ever-changing landscape of eSports.

Q: How has the explosion of professional eSports altered the course of gaming at the local level?

ZJ: Games are building online "ranks" into their system more these days that players and teams are content to play more casually and do not seek out opportunities for additional competition.

Q: For most traditional sports, we have a very well established tiered structure: professional, collegiate, and high school. In some sports, fiece competition extends to the middle school and youth sports level. Why do you think this hierarchy doesn't really exist in eSports?

ZJ: Right now, the cream of the crop just plays together online, so anyone below that level just doesn't participate due to the fact that they will get stomped.

The reason why high school vs. high school competitions are fun in sports is because as kids grow up the teams constantly change

but are usually pretty equal in skill sets so everyone feels like they have a chance. If you play high school basketball, you aren't going up against LeBron James in a tournament.

Q: To a certain extent, we're getting more structure at the collegiate level, thanks to groups like Tespa (fka Texas eSports Association) and colleges themselves launching eSports programs. Do you envision formal, school-sponsored eSports eventually taking root in a similar fashion?

ZJ: Unfortunately, there are problems getting a lot of the most popular games into high schools. Look at one of the most competitive eSports title around, Counter-Strike. Schools won't sanction games like that, which involve guns and killing your opponent. Maybe something like Rocket League would work, but nothing with any mature themes.

Q: What role do you envision LAN centers, gaming cafés, etc. taking in developing eSports at the local level?

ZJ: Personally, my own centers were started because we want to encourage social gaming. Get out of the basement and actually get to know players in real life that live around you. My favorite example is when the shy, small, socially awkward high school sophomore was teamed up with a collegiate scholarship football lineman in Halo. The two of them actually became really good friends, and without my center they would never even have crossed paths.

obviously keeps track of a team's roster, but it can also collect each member's assortment of personal gaming-related accounts, displaying things like Xbox Live IDs and Twitch profiles.

"We're in a really exciting position right now," Brown says. "We've laid the foundation to scale to hundreds of games,

and now we're coming back around and talking directly with teams about how to make Guilded work better for their specific communities."

Realizing the similarities between eSports and traditional sports teams, TeamSnap (<https://www.teamsnap.com>) targets both with its team management

platform. “The more competitive the team, the more organized they often are,” says Ken McDonald, TeamSnap’s Chief Growth Office. “We see this in all sports including gaming groups.”

According to McDonald, TeamSnap started out of its founders’ frustration running their own teams. They built the platform for themselves, but interest in it grew through word of mouth, and TeamSnap made its tools available to the public.

TeamSnap focuses heavily on planning and coordinating team events. There are a variety of scheduling features, obviously, as TeamSnap lets team managers plan practices, matches, and tournaments and then sync the dates and times across teammates’ devices and calendar apps (such as iCal, Google, or Outlook). It can track player availability, send messages to teammates, and collect payments. Although eSports teams and guilds rarely require their members to pay dues or fees, it could be a handy way for a gaming clan leader to register for an entire LAN party table to ensure everyone is seated together and then let the rest of the squad reimburse him later.

“Good teams and clubs make it clear what is expected of each team member so they can focus on the competition, not the logistics,” McDonald says. “For example, when you have a central schedule, one person can update the schedule and have it sync to everyone’s phones. That way, everyone has the latest schedule in their personal calendar on their phone without having to watch for a blizzard of texts about schedule changes.”

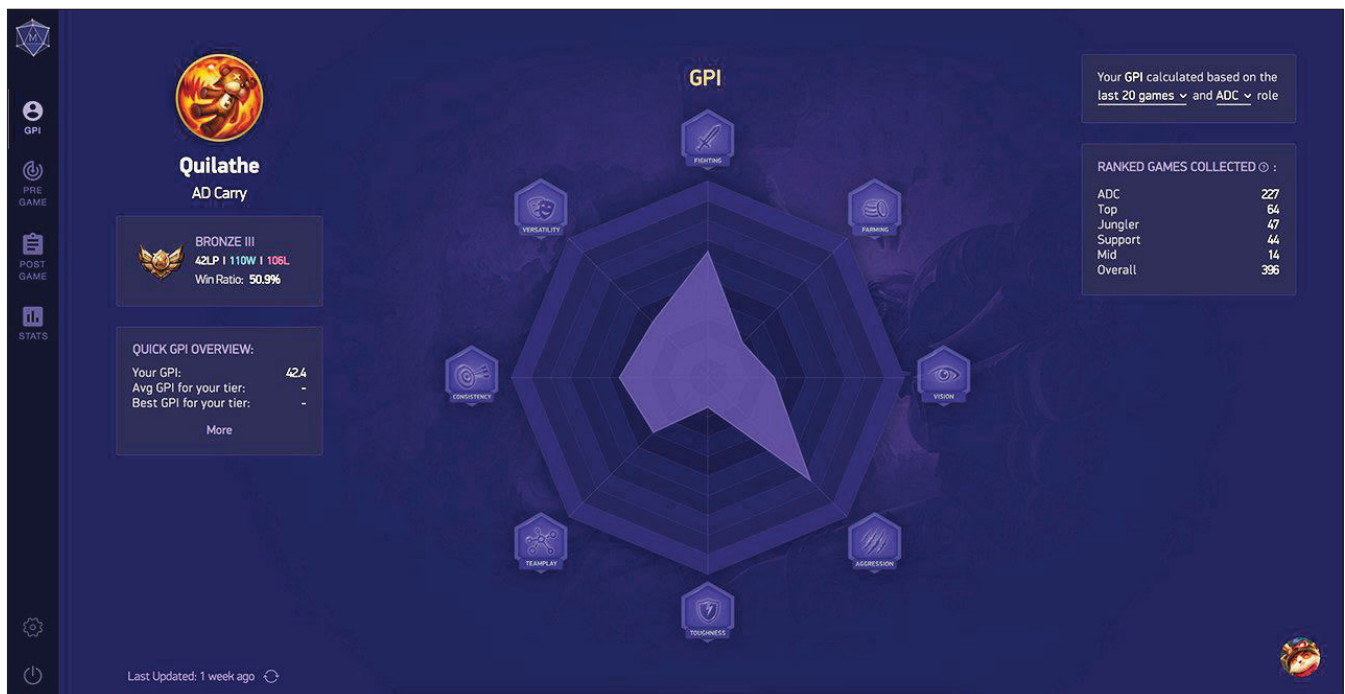
Moneyball Meets eSports

Before it was a critically acclaimed and Oscar-nominated film, Michael Lewis’ “Moneyball” revealed a new approach Major League Baseball teams were implementing to gain a competitive edge against their opponents. As deep-pocketed teams used their wealth to assemble all-star rosters, teams with limited budgets required creative and unorthodox strategies to find quality players. By applying sabermetrics, a term that now broadly refers to using statistical analysis to more accurately assess player potential, these teams were able to identify unheralded baseball players who

were likely to succeed at the pro level and then acquire them at deep discount. While big-budget organizations relied on baseball scouts to tell them what players “looked” good, others, such as the Oakland Athletics and its general manager Billy Beane, turned to spreadsheets and stats in their hunt for big leaguers.

Sabermetrics revolutionized baseball. It spread like wildfire among MLB front offices and has permeated other professional sports, as well. Now, the sabermetric philosophy has made its way to eSports, and companies have seized the opportunity to put another tool in teams’ toolbox.

Mobalytics (<https://mobalytics.gg>) is a startup headquartered in Los Angeles that’s bringing analytics to eSports; at the time of this writing its focus was League of Legends, but the company already has plans bring its service to CS:GO, Overwatch, DOTA 2, and other popular games. Poised to celebrate its first birthday at the time of this writing, Mobalytics has had a busy year. After beating a field of 24 other startups to win TechCrunch’s 2016



Numbers don't lie, and Los Angeles-based startup Mobalytics is banking on using statistical analysis to uncover insights that will help players up their game. The company's software collects data about a player's performance and assigns a GPI (Gamer Performance Index) that breaks down strengths and weaknesses into several key metrics.

Disrupt San Francisco Startup Battlefield (and taking home \$50,000 in first-place prize money), Mobalytics secured \$2.6 million in seed funding from a number of investment firms.

Of course, videogames already lend themselves to statistical analysis, but Mobalytics wants to go beyond simple measures such as kill:death ratio.

“The three major U.S. sports are all using increasing analytics as years go by,” says Amine Issa, Ph.D., Mobalytics co-founder. “The big advantage videogames have is that every piece of data is recorded by nature of the eSport being played on a PC.”

The front end, as it were, of the behind-the-scenes number crunching Mobalytics’ services does is its Gamer Performance Index (GPI). Mobalytics relies on machine-learning algorithms to assess a player’s overall performance and then represents that performance with a numerical GPI. The top-level GPI score breaks down further into a series of other metrics, such as Teamplay, Fighting Skill, Toughness, Vision, and others. Each of these is further divided and quantified. For example, Mobalytics scores someone’s Teamplay skill based on the following criteria: Ward Participation, Assists Participation, Objective Play, Team Fight Participation, Utility, and Kill Stealing. Receiving low scores in any of Mobalytics’ metrics helps players find holes in their game and gives them a much better idea of what they need to work on in each practice session. Mobalytics prepares pre- and post-game analysis, keeps track of players’ personal records, displays a host of statistics, filters results according to the specific champion a player used in a particular match, and so forth.

Currently in private beta, Mobalytics isn’t limited to professional eSports teams, although some are already using the service. Other gamers can sign up for an invite and use the tool to measure their performance in LoL, and Issa says an open beta is set to launch at the beginning of August.

StatsHelix (<https://statshelix.com>), which currently serves professional CS:GO teams, supplements the stats it presents with a browser-based 2D viewer that recaps matches in a number of useful

ways; together, they constitute what StatsHelix calls its ProTool.

Arguably the killer app of ProTool is its heatmaps feature. Another technique borrowed from pro sports, heatmaps provide powerful visual data about team and player performance. In CS:GO, the ProTool’s heatmaps details team positioning, where kills happen, and more. ProTool also lets players develop online playbooks akin to what sports teams use, and professional athletes are taking notice.

“[There are] strategies and tactics in playbooks just like other mainstream sports,” former NFL defensive lineman

respective games, and they’re a staple of most LAN parties, as well.

We usually see the thrilling side of tournaments—watching our favorite eSports team claw its way through the bracket or actually playing in tournaments ourselves—but someone has to put everything together. It doesn’t matter if a tournament is taking place at gaming’s highest level of competition or at a 25-seat weekend LAN party, almost every tournament requires dedicated personnel to ensure that tournament goes off without a hitch.

In the last few years, competing

The screenshot shows the Toornament website interface. At the top, there's a navigation bar with the Toornament logo. Below it, the page is divided into two main sections: 'Follow featured tournaments' and 'Play in open tournaments'. The 'Follow featured tournaments' section lists five tournaments: 2017 LMS Summer, 2017 LCK Summer Split, 2017 EU LCS Summer, 2017 GSL Season 3: Code S, and 2017 NA LCS Summer. The 'Play in open tournaments' section lists four tournaments: 4ème Tournoi FIFA 17 Gamers CI, ESISRAEL SVS NIGHTCUP #1, Southern Overwatch League, and LBR6#1 Qualify Champions(XBOX). Each tournament entry includes a small icon, the tournament name, and a brief description. At the bottom of each section, there are buttons labeled 'More featured tournaments' and 'More open tournaments'.

Once upon a time, gaming tournaments came together by passing a sheet of paper from seat to seat. Now, platforms like Toornament automate much of the process, both for organizers and competitors.

Ricky Lumpkin told PvP Live. “I saw what [eSports teams] Liquid and F3 had with StatsHelix, and I can tell you what I told them when I saw it: ‘This looks like the same things I get from coaches to study.’”

A Little Friendly Competition

When you want to crown a champion, whether in eSports or any other sport, a tournament will let teams and individual players slug it out until only one remains. Tournaments like The International or the Halo World Championship are the pinnacle of their

platforms have helped simplify tournament organization for both tremendous, sold-out arena events and local gatherings alike. Toornament, which boasts a client list of DreamHack, Activision Blizzard, and Ubisoft, to name a few, is a free service that puts a small arsenal of features at organizers’ fingertips. Since the end of 2015, Toornament has hosted nearly 60,000 tournaments on its platform. Another flourishing eSports tournament service provider is Battlefy (<https://battlefy.com>), which has a similar cachet among the eSports industry, as

Riot Games, EA, ESL, DreamHack, and others have used its platform.

Although services like Toornament and Battlefy serve the biggest and most prestigious tournaments in eSports, Daudign says that competitive gamers and tournament organizers at all levels stand to gain from using one of these services.

"[Any tournament organizer] has to run their tournament according to best practices for each specific game," he says. "If they do it manually, then the local community won't follow, they won't register. They'll tell the organizer, 'This is how we play the game.'"

Daudign adds that that automation is essential as eSports tournament service providers and organizers plan competitions in the future. Providers' software can connect to game servers, and APIs let organizers embed tournament brackets, forms, and live results directly into their websites. "Game developers and publishers are taking their role in eSports more seriously, so they need help to make sure the community has the tools to integrate with their games. They use us to bring the best practices in game tournaments to the games themselves."

Getting The Gamer Next Door

As gamers continue to battle each other online, local establishments and event planners face a conundrum: How do you lure these players out of their lairs and get them to gather together and play locally?

Zack Johnson, founder of ggLeap (<https://www.ggleap.com>) and ggCircuit (<https://www.ggcircuit.com>), believes that local gaming centers possess plenty of potential. ggLeap and ggCircuit are his one-two punch to give these establishments, along with retail outlets and other physical locations, the necessary tools to keep gamers and customers engaged and excited. He says that ggCircuit handles

the competitions, while ggLeap is the management platform centers can use to keep their operation running smoothly.

Johnson stresses automation and gamification (players using the services earn virtual currency they can then redeem for prizes, concessions, etc.) as key elements ggLeap and ggCircuit address. "We can help them get up and running efficiently, and our software keeps them running. They can then focus on the marketing and events side for their stores."

"Our goal is always automation and what we call the gamification of eSports. We want the competition itself to be a game. Climb the leaderboards, see your name in lights, play multiple games, and of course earn prizes."

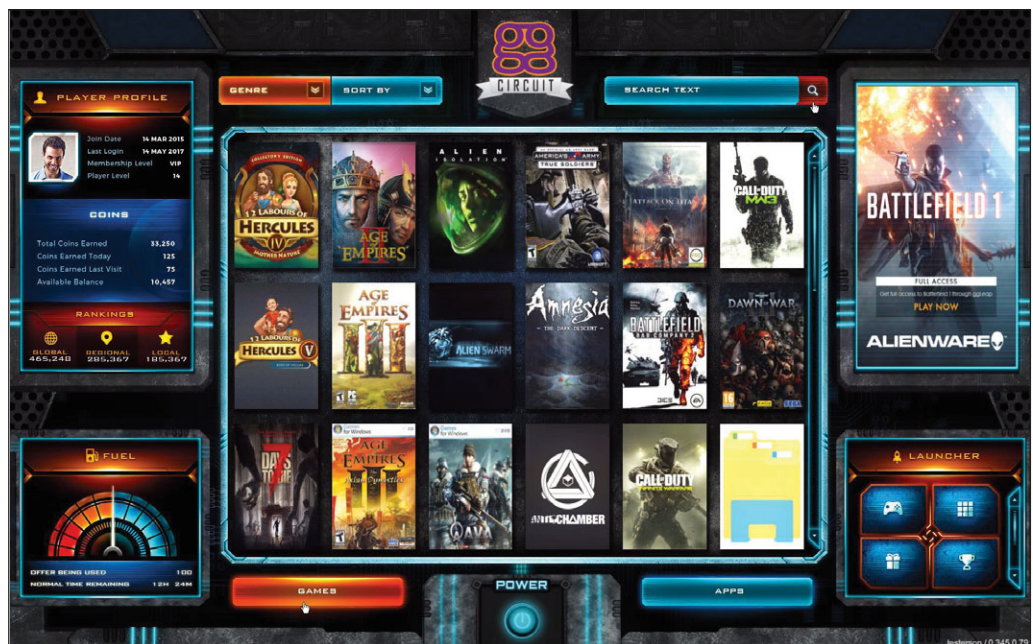
Despite the explosion of eSports and online multiplayer gaming, LAN parties across the country continue to thrive, but that doesn't mean these events will succeed by default. LAN party organizers are also turning to specialized service providers to assist with logistics.

"We believe in helping LAN parties grow without getting in their way,"

says Jeff Lefebvre, founder and CEO of LanHUB (<https://lanhub.net>). "We do this by providing a suite of tools that is simple to set up, easy to use, and gives players and staff a place to call home."

As LAN parties evolve from informal gatherings of friends to bigger events that hope to attract other local gamers, Lefebvre says services like LanHUB can minimize growing pains. "We observed that when 'living room parties' grows to gym-sized events, unexpected problems start to occur. There are too many players to manage, and players are left with a sour taste." Organizers use LanHUB for obvious administrative tasks such as player registration and seat maps, but it can also conduct straw polls and integrate with Twitch.

Regardless of where eSports teams and other gamers choose to compete, software companies and service providers are developing offerings aimed at taking care of a lot of the drudge work. With the logistics under control, we can focus on what really matters: the spirit of competition and the thrill of victory. ■



Brick-and-mortar establishments such as LAN centers and gaming lounges continue to be places where gamers can come together and compete locally. Modern service providers such as ggLeap help these places automate the game management and competition processes, leaving owners to handle the business side of their operations.

CPU

Game Of The Month

Yeah, we know you have blogs to post, video to encode, reports to write, and code to compile. We do, too, but you have to take a break once in a while (and maybe blow some stuff up). That's why each month we give you the lowdown on what to expect from the latest interesting games.

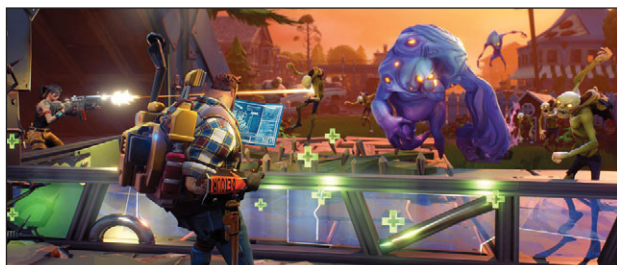


Epic Games' answer to gamers in search of something new? Everything! (No, not our May 2017 issue Game Of The Month.) Hungry for a horde mode showdown? Play Fortnite! Do you prefer your lighthearted heroes in the spirit of Overwatch and Team Fortress 2, rather than overmuscular grimdark soldiers? How about Fortnite? Oh, you've long pined for an FPS version of Minecraft? *[Slides controller across the table, with a tempting whisper, "Fortnite."]*

Fortnite keeps the prologue short and sweet: Ninety-eight percent of the world's population vanished after the Storm rolled in, and it's about to make life miserable for the remaining 2%. You see, when this tempest starts roiling, the forecast calls for a 100% chance of bloodthirsty Husks. What's a resourceful, reasonably well-armed survivor to do?

You dig into Fortnite's bread and butter: builders building buildings. Firepower alone can hold off the Storm's legions for a while, but to truly outlast wave after wave of monsters, you need that fort, which can range from Hooverville-inspired shack to an upcycled Minas Tirith tribute. The one silver lining of the overwhelming majority of humankind vanishing is that there isn't much competition for building mats, so start scavenging.

Fortnite's classes each come with distinct specializations; a couple of them are rightfully tied to gathering supplies and constructing more resilient bases, but otherwise the Outlander, Soldier, Ninja, and Constructor all have relative analogs in other games. The tech tree is executed reasonably well and turns



Habitat For Humanity

BY VINCE COGLEY

\$39.99 (PC, XOne, PS4) • ESRB: (T)een
Epic Games • www.epicgames.com/fortnite

out to be quite expansive. We also liked the small mountain of weapons Fortnite lets you customize, even if, again, the overall feel is all too familiar.

So even though Fortnite falls short of revolutionizing the genre, that really doesn't matter because it's just a hell of a lot of fun. Scouring maps for resources and assembling your secondhand ramparts is a blast, and Fortnite's emphasis on co-op rather than PvP is, to be honest, refreshing in a climate of big-budget games angling to be the next eSport. Sometimes, you just want to waste a few bad guys without worrying about what a slip-up will do to your ladder rank or worse, your spot on the team.

Until 2018, when Fortnite becomes free-to-play, it will cost you at least 40 bucks for early access privileges. We say "at least," because you can splash out even more cash, up to \$149.99, for premium editions that are bursting with loot piñatas (no, really), XP boosts, hero packs, and more. It's not hard to see how Epic has stitched together a money-making monster while simultaneously dangling a \$0 price tag in front of gamers next year.

The real question isn't whether you should play Fortnite—you absolutely should; it's whether you should pay for the head start. You might be tempted to snark that Fortnite is little more than a mashup of Left 4 Dead 2/Overwatch/Dungeon Defenders/Etc./Etc./Etc., but let that hot take simmer for a few rounds. Sure, you've played Fortnite before, but you haven't played *Fortnite*, and it won't take much of the latter before you stop caring about the former. ■





If you've ever wanted to know what it would be like to be stranded on Mars with naught but your spacesuit, a really fancy screwdriver, and your wits, then the Steam Early Access game ROKH is as close as you're going to get. The game takes place in the near future. You are a science-minded explorer (or explorer-minded scientist), not unlike Mark Watney, the central figure of Andy Weir's novel "The Martian." The difference here is that the major catastrophe has already occurred to your predecessors.

You are part of a second wave of colonists to take up residence on the Red Planet. As you'll soon discover, something tragic and mysterious happened to the first wave, and you can wander around abandoned structures and discover clues aplenty. From what's currently playable in the alpha build, you can choose to focus on building a base and planting roots, or you can set out to explore the harsh and unforgiving portions of the map to the south and east, without much to hold you back other than your constant need to periodically re-up on oxygen, water, suit power, rad shields, and food.

This is a survival/crafting/building game inspired by the likes of Ark: Survival Evolved, Rust, The Forest, and 7 Days To Die. I'll be the first to admit that survival games in this vein are divisive, and generally speaking, most of us already know whether we love them or hate them. In the several hours that I've spent playing ROKH, I've found nothing that would tempt those who are critical of the genre to give it a shot. But for those who find a certain joy in punching trees, being homicidal nudists, or spending hours upon hours upgrading tools to upgrade other tools, ROKH shows signs of potential greatness.

One of the major things ROKH has going for it is its deep crafting system. Even though we were only able to access the first few levels

ROKH

BY ANDREW LEIBMAN

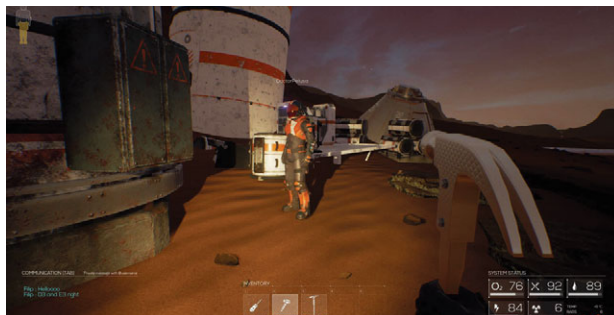
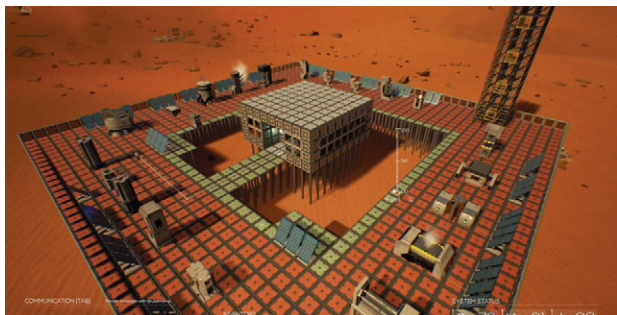
\$24.99 (PC) • ESRB: (M)ature • Nvizzio Creations
www.rokhthegame.com

of tools and components, transitioning from tier-two items to tier-three was an absolute thrill, and really opened up some vital components, machines, and upgrades that made life on the desolate planet much more survivable. During my time with the game, a major update launched which managed to streamline the crafting experience without stripping away any of the depth.

The other major plus for us was the setting. The Mars landscape looks as magnificent as it is deadly; stepping into a steep crater can result in a quick demise. Storms and meteor showers plague the planet surface, and there are hints that more dangerous foes are waiting just out of sight. Resources are abundant, but to take full advantage of them will take time.

Unfortunately, the current state of the game is such that framerates can bounce around wildly depending on what's onscreen. We experienced repeated crashes, and sometimes the server where we've spent a majority of our time was simply not accessible. The UI, although improved following the recent update, was still a bit of an unintuitive mess. While we're of the opinion that hand-holding tutorials can sap the joy of discovery in games of this type, Nvizzio Creations needs to better convey to the player how a tool functions in various situations. In case you're new to the game, banging the wrench against your automated Tile Press won't fix it.

This game shows a lot of promise, but it still needs work. The developers have committed to a strict launch window, within 12 months of May's Early Access. We're looking forward to checking back in with ROKH early next year to see if the game lives up to its potential. ■





Bungie recently gave Destiny fans everywhere an early peek at its upcoming mega-sequel, *Destiny 2*, in the form of a beta that was open first to folks who pre-ordered the game on PlayStation 4 (this began on Tuesday, July 18), then to those who pre-ordered it on Xbox One (July 19). The beta continued in its restricted form through Friday, July 21, at which time it became open to all PS4 and Xbox players regardless of their pre-order status, and although it was originally scheduled to wrap up on Sunday, July 23, Bungie announced via Twitter that it was extending the beta through Tuesday the 25th.

The beta was pretty straightforward; it let you choose a titan, warlock, or hunter, and then dropped you immediately into an introductory campaign mission called "Homecoming," which picked up with a scene from the "Our Darkest Hour" trailer that Bungie unveiled at E3. The Vanguard (the hunter Cayde-6, warlock Ikora Rey, and titan Zavala) are in the tower when a massive alien fleet attacks the city. Your character is returning from . . . somewhere (maybe a strike, maybe a patrol, who knows?) and your ghost (not a Dinklebot, unfortunately) tries and fails to reach the Tower on coms.

When you arrive, the city is in flames and Cabal forces are everywhere, and the fighting starts. The mission didn't take terribly long to play through, but it was a nice introduction (or re-introduction, if your *Destiny* skills have lapsed like mine did) to the game's excellent FPS combat. Once you completed the mission, which ended with a very cool cinematic that introduced Dominus Ghaul, leader of the Cabal's elite Red Legion, you were taken into orbit and given three new activities to choose from.

One was a three-player strike called "The Inverted Spire," and it showed off a bit of one of *Destiny 2*'s new world locations, the minor planet Nessus. In the strike, you learn that Nessus is a Vex planet, but that the Red Legion has begun drilling deep into the planet for something on a massive scale. The Vex,

Beta Verdict: We're Good

BY CHRIS TRUMBLE

\$59.99 (PC, Xone, PS4) • ESRB: (T)een • Activision
www.destinythegame.com

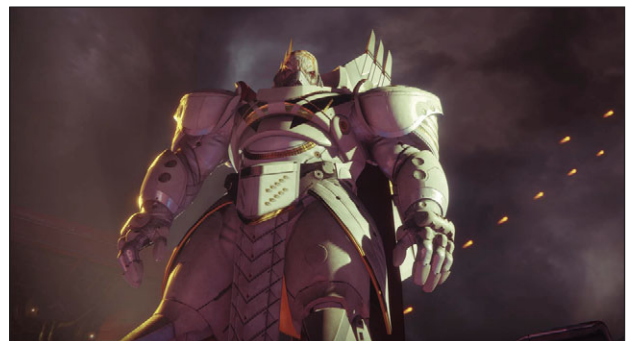
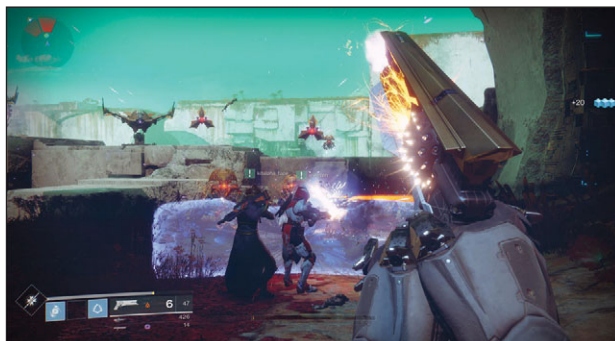
of course, take exception to this Cabal incursion, and as a result you'll see Vex and Cabal forces fighting each other almost as often as you have to fight either one of them. (You'll even fight a few Fallen here and there, for some reason that may or may not become clear later.)

The other two activities are Crucible (player vs. player) matches. One is a Quickplay match of the Control match type, which takes place in a level called "Endless Vale," and the other a Competitive match of the Countdown match type played in a map called "Midtown." For now at least, competitive multiplayer is limited to two teams of four players. The Control match type is one most multiplayer shooter fans are very familiar with; variants of it are found in *Overwatch* and *Halo*, among others. Countdown is somewhat reminiscent of *Counter-Strike*'s bomb scenarios, except that there are two, fixed-position bombs placed at locations in the map. One team tries to detonate, the other to defuse.

The PvP matches are fast and fun, and PvP should be a huge draw again this time around. Ultimately, though, the biggest changes in the game look so far to be in the quantity, quality, and variety of PvE activities compared with the first game, and if you were roundly disappointed in the campaign and story-based activities in *Destiny*, you might want to give *Destiny 2* a look when it ships. One thing for sure the recent beta demonstrates is that Bungie still knows how to make a great shooter; the control, mechanics, and technical aspects of the game (sound and graphics) were mostly impeccable. There were a few areas of concern with regards to balance, ammo drop rates, ability cooldowns, and the like, but Bungie has addressed those in positive ways, as well.

Long story short, if you liked *Destiny*, you may well like *Destiny 2* even more, and you may like *Destiny 2* a lot even if you weren't a fan. It's early, of course, so we'll see. The game ships for consoles on September 6, and for PC on October 24. In the meantime, if you're interested in checking out the game on PC for the first time, good news! Bungie says there will be a PC beta in August.

See you in there! ■





One of the things we love most about Steam is that it provides a mechanism for small developers and publishers to get their games in front of players who are interested, and although there are plenty of indie disappointments, you can find some gems if you look. We recently bumped into an indie title called *Tower of Time*, developed and published by a small developer in Poland called Event Horizon, and had quite a bit of fun with it.

Event Horizon launched *Tower of Time* as an Early Access title on July 13. The game is a single-player, isometric top-down dungeon crawler with RTS elements that takes place inside a huge, multi-level tower that was unearthed during an earthquake in a dying world. Your character was drawn to the tower as a child, and you briefly entered the structure and talked to a presence that said you'd return someday to claim the power waiting there for you. Many years later, you indeed re-enter the tower in search of resources to help the citizens of your city, where continuous failed crops and the scarcity of clean water have threatened your people's future.

You initially return with two trusted friends and warriors, a prototypical male fighter and a female archer. They encourage you to let them go ahead and scout the tower and make it safe for you, which works out as you have a date with a large crystal throne you first glimpsed as a child. From that point on, you direct your companions' actions via the power of the throne, and as the game progresses you are introduced to new characters to add to your party of up to four.

Your team will explore the tower, fight monsters, and gain valuable insight as to what your world was like before its decline, as well as what caused it

Dragon Age Lite

BY CHRIS TRUMBLE

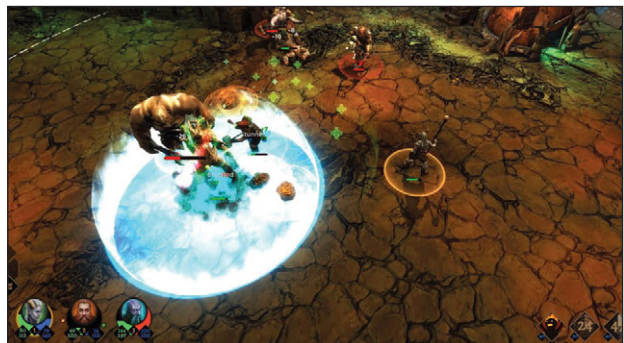
\$14.99 (PC) • ESRB: n/a • Event Horizon
www.evehor.com

to begin dying in the first place. Most battles you can choose to initiate or postpone, as you can see many of the monsters in the tower milling about and waiting to kill you. Some battles, though, are unavoidable: sometimes your party is ambushed, and other times you have to engage an enemy force to progress further into the tower and solve its mysteries.

Once you enter combat, the game switches perspectives to give you a broader view of the battlefield, and you are allowed to position your adventurers wherever you like prior to starting the fight. This is advantageous for getting your ranged fighters and casters where they can be most effective, although you'll need to move all your characters around quite a bit during some fights. Once you start each battle, enemies will spawn from multiple locations on the map and attack, and you'll control your team members' movement and abilities in real-time while managing their health, mana, and ability cooldowns.

The game's combat isn't unlike the Tactical View in EA and Bioware's *Dragon Age* games, and although you can't freeze the fight completely, there is a Slow Time button that you can use as much as you like when things get hairy. And things will get hairy; the first few fights might suggest otherwise, but once you have a full party and have to manage ranged DPS, melee, and healing/buffs in real time, you'll be glad you can slow things down occasionally.

There are plenty of time-worn fantasy tropes on display in *Tower of Time*, and we ran across a minor glitch or two, as well, but given its Early Access status and its very budget-friendly price of \$15, we think there's more than enough fun in this game to outweigh such concerns. ■



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Source Gaming Lounge
Denton, TX
www.sourcegaming.org

08.24-27.17

QuakeCon
Dallas, TX
www.quakecon.org

08.25-27.17

AWOL LAN 30
Eau Claire, WI
www.awollan.org

09.01-04.17

PAX West
Seattle, WA
west.paxsite.com

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LanOC v21.0
Van Wert, OH
lanoc.org/lan-parties

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PONG EXPO LAN
Menomonie, WI
pong.uwstout.edu

09.29.17

Bluebonnet LAN
Arlington, TX
utaesports.com

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www.fortlan.org

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BaseLAN 32
Winnipeg, MB
www.aybonline.com/baselan-32

11.03-06.17

PDXLAN 2017
Portland, OR
www.lanreg.org/pdxlan/pdxnov2017

11.17-19.17

Windy City LAN 3.0
Chicago, IL
www.windycitylan.com

11.10-11.17

True Gamerz Expo
Jacksonville, FL
www.beaucoreenterprises.com

11.17-19.17

November LAN
Menomonie, WI
pong.uwstout.edu

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Oklahoma City, OK
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KCGames On 78
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Q&A With Lenny Tang

MSI's No. 1 American Laptop Marketing Mgr. On New Raider Gaming Laptops

Q: Hi Lenny! So, tell us about MSI's new GE63VR and GE73VR Raider laptops. This is an all-new design, correct?

LT: Hey! MSI's New GE63VR and GE73VR Raider laptops are absolutely awesome. These newest-generation GEs feature an all-new design with a streamlined racer look, and the specs are packed to match. The dynamic brushed aluminum alloy chassis, new keyboard frame, and four-way exhaust gives the Raider a premium feel. The bottom side has a new MSI dragon and large air inlets to keep your laptop cool.

Q: We were looking over the specs, and a few things jumped out at us. For starters, can you tell us about the new displays in these models?

LT: This is one of my favorite features of the laptop. The GE63VR now comes equipped with a 120Hz refresh 3ms response time screen panel. This panel is great for games like CS:GO or Overwatch, where split millisecond reactions are needed. You can definitely feel a difference from traditional monitors when you're playing on this laptop. On top, the panel is calibrated to 94% NTSC and has a 170-degree view angle.

Q: What about audio? Looks like you have installed speakers by Dynaudio? What are the advantages of this setup vs. other laptop speakers?

LT: The speakers on the Raider is unlike anything I've ever heard



on any laptop, period. When I first got to play around with it, this was the first thing I tried out. The new Giant Speakers by Dynaudio sound like external speakers installed onto a laptop up to a whopping 106db. There are now four speakers, two dedicated bass and two for treble. The built-in ESS DAC fills the room with hi-res audio up to 192KHz/24bit. The YouTube music videos I watched had no distortion whatsoever, even at 100% volume; treble was clear and crisp, while bass was deep and powerful. Hands-down the best speakers I've ever heard on a laptop.

Q: Of course, CPU readers are going to want to know what kind of

CPU and GPU options the GE63 and GE 73 offer.

LT: The GE Raider series will offer only the Intel Core i7-7700HQ (2.8GHz to 3.8GHz) for all Raider configs. The GPU will vary from GTX 1050, 1050 Ti, 1060, and 1070.

Q: Also, it looks from what we've seen like these laptops have beefed-up cooling. Can you tell us about the new Cooler Boost 5 system?

LT: Cooler Boost 5 is a step up from previous notebook coolers, and we've added an additional copper heatpipe for the GPU. Cooler Boost 5 now comes with

four dedicated heatpipes for the GPU and three dedicated for the CPU. The reason behind this is to increase its passive cooling capability and reduce fan noise. The fan doesn't need to work as hard when its cooler has more surface area, and during normal light use, I barely hear the fan turn on at all.

Q : RGB LED backlight is a big deal right now, and it looks like the new laptops are set up with that. They have SteelSeries keyboards, right?

LT : The Raider comes with a brand new Per Key RGB SteelSeries keyboard. You have ultimate control over your keyboard and the backlights. With the SteelSeries app, you can customize each individual key's RGB, program Macros, and create different profiles for different games.

Q : What about storage options?

LT : There's a mix of storage options, and so far all of the configurations except one come with at least a 512GB SSD and at least a 1TB hard drive for storage. You can find more on the exact SSD and HDD space on our website at us.msi.com.

Q : The model numbers for these laptops both include "VR"; that combined with the GPUs suggest that they are ready to drive VR gaming?

LT : Exactly, we've added the VR into the model name to help customers know that this is a VR-capable laptop, which is defined as any that has GeForce GTX 1060 or higher graphics.

Q : What kind of user are these laptops designed for?

LT : The Raider has all the features of a high-end gaming PC, and that's who it's designed for—those who want all the premium features of a gaming PC in the form factor of a laptop. The high-refresh panel is matched with graphics that can power it, upgraded speakers that really blow you away, and the fastest components to keep your laptop futureproof.



The new, 15.6-inch GE63VR Raider from MSI.



MSI's 17.3-inch GE73VR Raider.

Q : Thanks for your time, Lenny! What else would you like readers to know about the GE63VR Raider and GE73VR Raider?

LT : They are available now at your favorite retailers, and I hope you get to enjoy the power of a true gaming laptop from MSI! ■



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